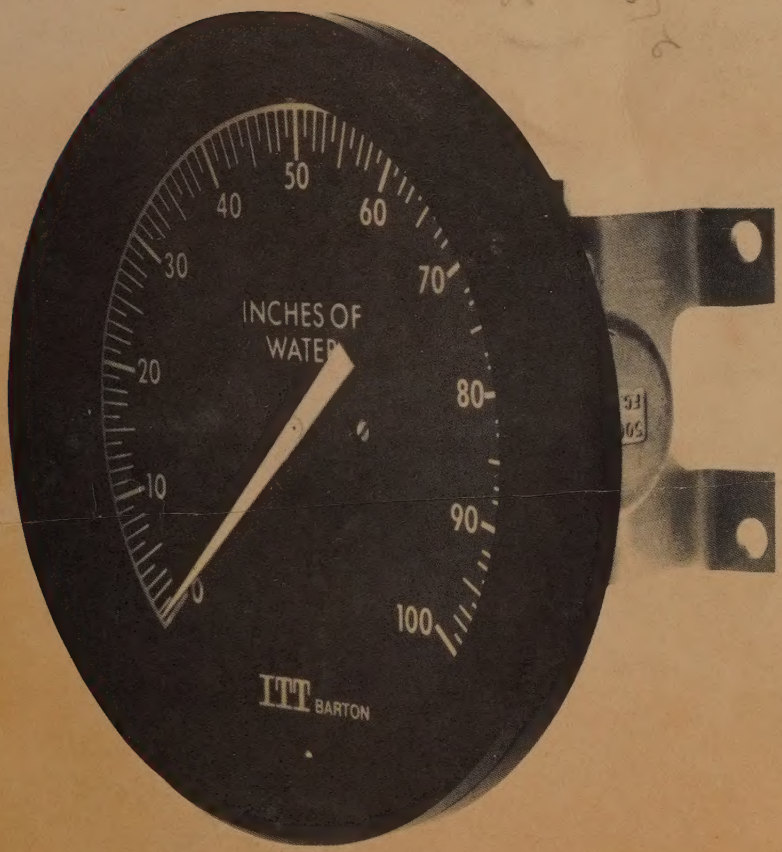
ITT BARTON

Technical Manual

Models 227 & 247 Differential Pressure Indicators



Please return to:
Tim Gerler X-5757
5618
FMU 139/B

Manual No. 83A3

TECHNICAL MANUAL

MODELS 227 & 247
DIFFERENTIAL PRESSURE INDICATORS

ITT BARTON INSTRUMENTS
P.O. Box 1882
900 S. Turnbull Canyon Road
City of Industry, CA 91749

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WARRANTY

The warranty of the Differential Pressure Unit will be voided if the following limitations are exceeded:

TEMPERATURE: Do not subject the DPU to temperatures above 200°F or below -60°F (35°F minimum for water filled units).

PRESSURE: Do not subject the DPU to operating pressure in excess of the working pressure rating stamped on the housing of the unit.

CORROSION: Do not subject the DPU to incompatible process media.

SEALED COMPONENTS: Do not loosen or remove the torque tube gland nut, the drive arm hole plug, or the torque tube housing from the center plate (see Figures 1-2 and 1-3 of the Appendix). To do so will cause loss of bellows fill fluid and render unit inoperable.

VIBRATION: Do not subject the DPU to severe mechanical vibration.

SHOCK: Do not subject the DPU to hydraulic shock.

PULSATION: Do not subject the DPU to severe pulsation.

WARRANTY LIMITATIONS

ITT Barton Instruments Company manufactures products which satisfy the exact definition of Quality, that is, they meet the specification as advertised or as stated by our customer. These products are intended to be used in accordance with the specifications and applications described in this document.

A limited warranty applies to ITT Barton Instruments Company products. ITT Barton Instruments Company will assume responsibilities for obligations, related to its products, which are specifically noted within the written warranty for a specific product. However, ITT Barton Instruments Company will not be liable for any loss, damage, cost of repairs, incidental or consequential damages of any kind whether or not they are based upon expressed or implied warranty, contract, negligence, or strict liability arising in connection with the design, manufacture, sale, use, or repair of the products, if they are used outside the constraints of recommended usage as set forth herein.

Any use or application that deviates from the stated performance specification is not recommended and could render the instrument unsafe.

SAFETY

Before installing the instrument, become familiar with the installation instructions presented in Section 3.

WARNING notes call attention to potential hazards or operating procedures which, if not correctly followed, could cause personal injury or death.

CAUTION notes call attention to procedures which, if not strictly observed, could cause damage to, or destruction of, the equipment.

WARNINGS and/or **CAUTIONS** appear on the following page of this manual and should be reviewed before proceeding: 5-1.

RECORD OF CHANGES

CHANGE NO.	DATE	DESCRIPTION	ENTERED BY
407-2 (A)	9/15/76	Title Page: Added 'A' revision & revised address. Added 'Record of Revision' page. Page 1-3: Added new photos. Page 1-5: Revised Table 1-1, 'Indicator Models 226 and 227' to latest specifications.	D. Edmiston
407-2 (B)	12/29/78	Title Page: Added 'B' revision. Page 6-7: Revised Figure 6, 'Models 246/247 D.P. Indicator Parts Identification' to change manifold and add hose assembly. Page 6-8: Detailed manifold parts and added reference to indicator assemblies. Page 6-2: Added another snap ring (Item 13).	J. Herrick & J. Wolarik
79K5	3/14/80	Assigned new manual number; revised text and illustrations; set to new format.	J. Herrick
83A3	11/82	Revised text. Deleted information pertaining to Models 226 & 246 D.P. Indicators.	P. Shepherd

TABLE OF CONTENTS

SECTION	TITLE	PAGE
1	**INTRODUCTION**	1-1
	1-1. General	1-1
	1-2. Product Description	1-1
	1-3. Specifications	1-4
2	**THEORY OF OPERATION**	2-1
	2-1. General	2-1
	2-2. Differential Pressure Unit	2-1
3	**INSTALLATION**	3-1
	3-1. Unpacking	3-1
	3-2. DPU Installation	3-1
	3-3. Mounting	3-1
4	**OPERATION**	4-1
	4-1. Start-Up	4-1
5	**MAINTENANCE AND CALIBRATION**	5-1
	5-1. DPU Inspection and Cleaning	5-1
	5-2. Tools Required for Maintenance	5-1
	5-3. Range Changes	5-1
	5-4. Bellows Unit Assembly Replacement	5-1
	5-5. Calibration Check	5-2
	5-6. Complete Calibration	5-3
	5-7. Troubleshooting	5-4
6	**PARTS LISTS**	6-1
	6-1. General	6-1
7	**DRAWINGS**	7-1
	7-1. Outline Dimension Drawings	7-1

APPENDIX — Technical Manual, Model 224 Differential Pressure Unit

LIST OF ILLUSTRATIONS

FIGURE		PAGE
1-1	Model 227 Differential Pressure Indicator	1-2
1-2	Model 247 Portable Differential Pressure Indicator	1-3
2-1	Differential Pressure Indicator	2-1
5-1	Indicator Mechanism	5-5
6-1	Models 227/247 Indicator Assembly	6-2
6-2	Model 247 Differential Pressure Indicator Parts Identification	6-5

LIST OF TABLES

TABLE		PAGE
1-1	D.P. Indicator Specifications, Model 247	1-4
1-2	D.P. Indicator Specifications, Model 227	1-5
5-1	Troubleshooting Chart	5-4
6-1	Parts List, Models 227/247 Indicator Assembly	6-3
6-2	Parts List, Model 247 D.P. Indicator	6-5

SECTION 1

INTRODUCTION

1-1. GENERAL

The ITT Barton Model 227 Differential Pressure Indicator (Figure 1-1) is an instrument used to measure liquid flow or liquid level, and is designed to be permanently installed into the process system.

The ITT Barton Model 247 Differential Pressure Indicator (Figure 1-2) is a portable indicator, and except for additional manifold valves and piping is identical with the Model 227 indicator.

For flow measurements, the instrument is connected to the low- and high-pressure sides of a primary device located in the process run. The primary device may be any pressure drop device such as an orifice plate, venturi tube, or flow tube.

For liquid level measurements, the instrument is connected to monitor changes in hydrostatic pressure caused by variations of liquid height in a vessel.

1-2. PRODUCT DESCRIPTION

The Models 227 and 247 Differential Pressure (D.P.) Indicators are actuated by an ITT Barton Model 224 Differential Pressure Unit (DPU).

The indicating pointer traverses a 270-degree arc to measure differential pressure, which implies flow or liquid level. The Models 227 and 247 have 6-inch dials with extended dial scales of 13½ inches for ease of reading.

The movement of the D.P. Indicator has micrometer screws for zero and span adjustments. These adjustments may be performed without removing the scale plate or the indicating pointer.

The DPU pressure housing of the Model 227 D.P. Indicator (which is designed for permanent installation into the system) has standard pipe connection ports.

The D.P. Indicator Model 247 is a portable unit, designed for intermittent measurements of flow rates or differential pressure. This model is provided with three-valve manifolds as an integral part of its design. The manifold is a unitized block construction having two block valves and a bypass valve. Valves are also provided at the DPU for bleeding or venting.

The Model 247 is a case-mounted instrument, and the case is provided with a hook for vertical positioning of the instrument.

The Model 224 DPU is described in the Appendix.

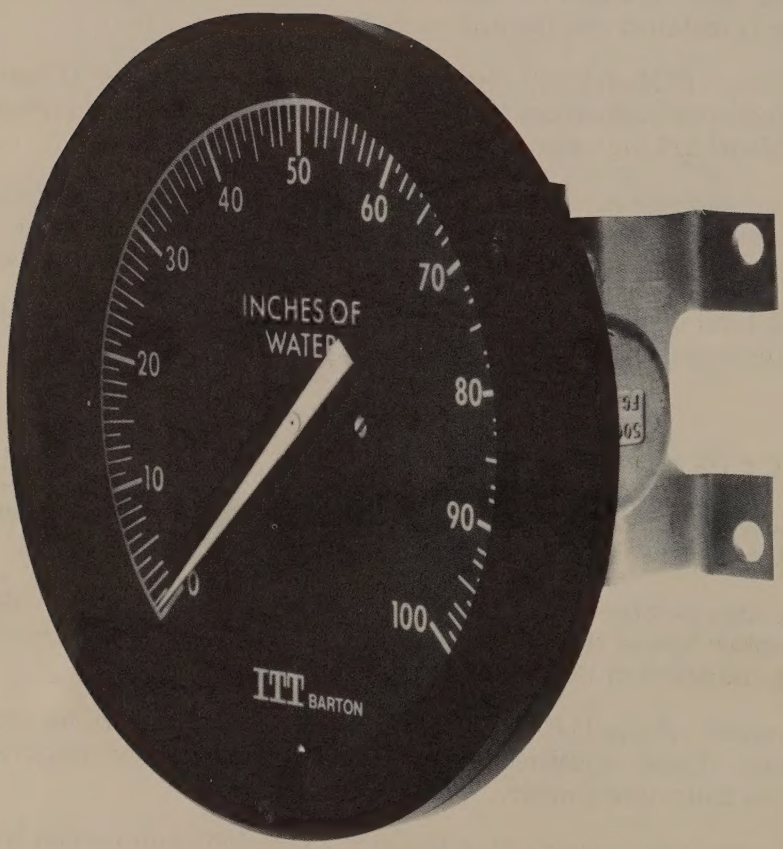


Figure 1-1. Model 227 Differential Pressure Indicator

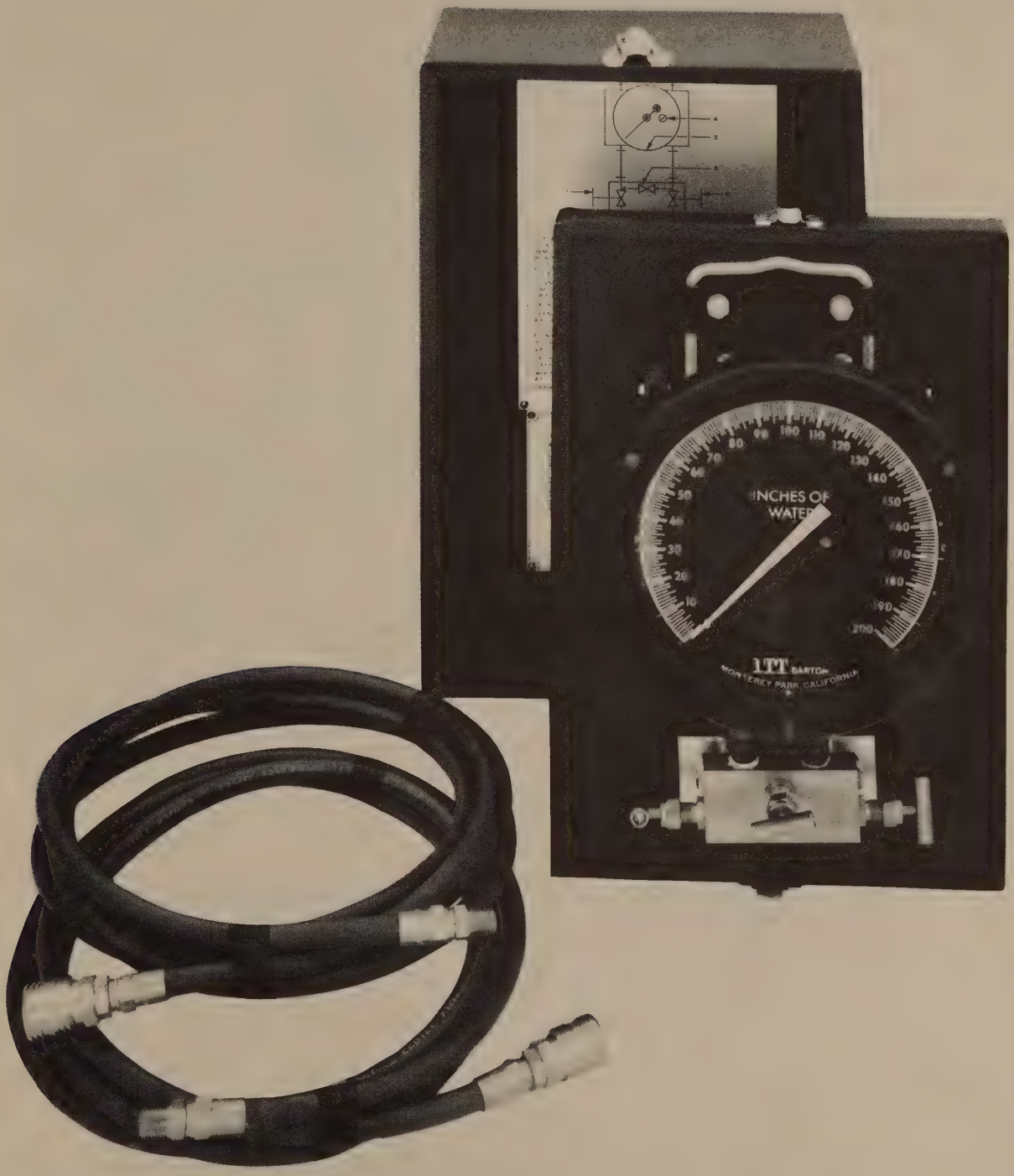


Figure 1-2. Model 247 Portable Differential Pressure Indicator

1-3. SPECIFICATIONS

The specifications for the D.P. Indicators are presented in Table 1-1.

Table 1-1. D.P. Indicator Specifications

General Performance

Accuracy: Ranges from 0-30″ w.c. to 0-200 psi ..... ±½% of full scale differential pressure
Ranges above 0-200 psi to 0-400 psi ..... ±¾% of full scale differential pressure
Temperature Limits ..... -60°F to +200°F
Water-Filled ..... 35°F to +200°F

Indicator Model 247					
		Available Differential Pressure Ranges			
		Stainless Steel Bellows		Beryllium Copper Bellows	
SWP-psi	Housing material	1⅝″ O.D.	¾″ O.D.	1⅝″ O.D.	¾″ O.D.
500	Forged Brass (ASTM-B124#2)	—	—	0-30″ w.c. to 0-24.5 psi	0-25 psi to 0-400 psi
500	Stainless Steel (316)	0-30″ w.c. to 0-55 psi	0-60 psi to 0-400 psi	—	—
Net Volume in cu. in.	L.P. Head	1.66	2.51	1.66	2.51
	H.P. Head	1.55	2.42	1.55	2.42
Displacement in cu. in.		0.14	0.03	0.14	0.03

NOTE

Zero center or split ranges are available on special order. For example, a 0-50″ w.c. range may be ordered 25-0-25″ w.c. or 10-0-40″ w.c. Absolute pressure ranges are available from 30″ w.c. to 400 psia.

Table 1-2. D.P. Indicator Specifications

Indicator Model 227							
Available Differential Pressure Ranges							
Meter Body		Stainless Steel Bellows		Beryllium Copper Bellows		Pressure Connections	
SWP-psi	Housing Material	1⅝" O.D.	¾" O.D.	1⅝" O.D.	¾" O.D.	Top	Bottom
500	Forged Brass (ASTM-B124 #2)			0-30" w.c. to 0-24.5 psi	0-25 psi to 0-400 psi	¼" NPT	¼" NPT
500	Stainless Steel (316)	0-30" w.c. to 0-55 psi	0-60 psi to 0-500 psi	0-30" w.c. to 0-24.5 psi	0-25 psi to 0-400 psi	¼" NPT	¼" NPT
1,000	Brass (Fed. Spec. QQ-B-637 Comp. 2			0-60" w.c. to 0-24.5 psi	0-25 psi to 0-400 psi	⅛" NPT ¼" NPT	⅛" NPT ¼" NPT
1,000	Copper Nickel (70-30) MIL-C-15726			0-60" w.c. to 0-24.5 psi	0-25 psi to 0-400 psi	MS16142-4	MS16142-4
1,500	Cold Rolled Steel (C1018) Stainless Steel (316)	0-60" w.c. to 0-55 psi	0-60 psi to 0-600 psi	0-60" w.c. to 0-24.5 psi	0-25 psi to 0-400 psi	¼" NPT	¼" NPT
3,000	Cold Rolled Steel (C1018) Stainless Steel (316)	0-60" w.c. to 0-55 psi	0-60 psi to 0-600 psi	0-60" w.c. to 0-24.5 psi	0-25 psi to 0-400 psi	½" NPT	½" NPT
6,000	Cold Rolled Steel (C1018) Stainless Steel (316)	0-70" w.c. to 0-55 psi	0-60 psi to 0-600 psi	0-70" w.c. to 0-24.5 psi	0-25 psi to 0-400 psi	9/16-18UNF for AMINCO ¼ ODT	9/16-18UNF for AMINCO ¼ ODT
10,000	Alloy Steel (4140)	0-100" w.c. to 0-55 psi	0-60 psi to 0-600 psi	0-100" w.c. to 0-24.5 psi	0-25 psi to 0-400 psi	9/16-18UNF for AMINCO ¼ ODT	9/16-18UNF for AMINCO ¼ ODT
Net Vol. in cu. in.	L.P. Head	1.66	2.51	1.66	2.51		
	H.P. Head	1.55	2.42	1.55	2.42		
Displacement in cu. in. for full-scale travel		0.14	0.03	0.14	0.03		

NOTE

Zero center or split ranges are available on special order. For example, a 0-60" w.c. range may be ordered 30-0-30" w.c. or 15-0-45" w.c. Absolute pressure ranges are available as listed above.

Other sizes and types of connections (welding stubs, MS, A.N.D., etc.) are available upon request.

Special bellows and housing materials can be made available such as Inconel 625 and Hastelloy-B upon request.

SECTION 2

THEORY OF OPERATION

2-1. GENERAL

The bellows within the DPU move in response to changes in the differential pressure monitored at the high- and low-pressure sides of the primary device installed in the process run. The DPU bellows movement is mechanically transferred through the indicator mechanism to position the pointer on the indicator dial.

2-2. DIFFERENTIAL PRESSURE UNIT

See the Appendix for the Model 224 DPU theory of operation.

2-3. INDICATOR (See Figure 2-1)

The torque tube shaft of the DPU is connected to the movement follower arm of the indicator mechanism. The torque tube shaft rotates in response to the differential pressure applied. The movement of the torque tube shaft is transmitted through the movement follower arm and the associated mechanism to set the indicating pointer at the position on the indicator scale relative to the differential pressure sensed by the DPU.

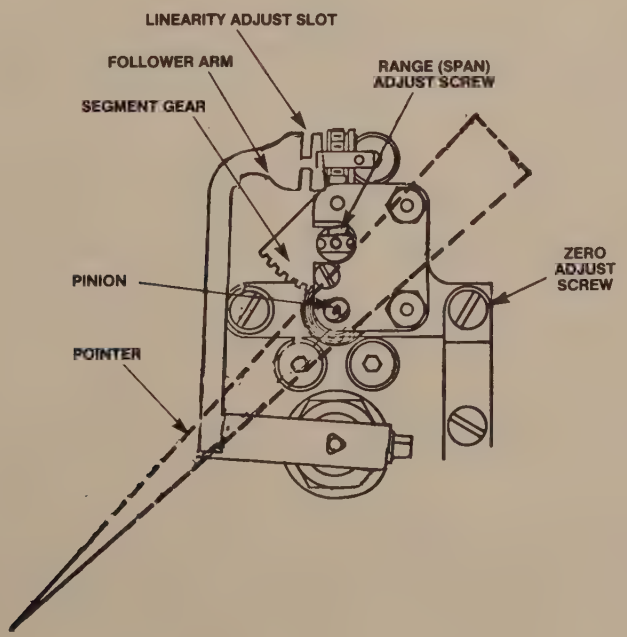


Figure 2-1. Differential Pressure Indicator

SECTION 3

INSTALLATION

3-1. UNPACKING

All ITT Barton instruments are tested and inspected during manufacture and prior to shipment. However, an inspection should be performed at the time of unpacking to detect any damage that may have occurred during shipment.

For applications in critical media, requiring special cleaning processes and precautions, a polyethylene bag is used to protect the instrument from contamination. This protective bag should be removed only under conditions of extreme cleanliness.

The following items are included in each container:

- Model 227 or 247 Differential Pressure Indicator
- Technical Manual
- Accessories per customer order.

3-2. DPU INSTALLATION

See the Appendix for DPU installation and piping instructions.

3-3. MOUNTING (Refer to the applicable outline drawing presented in Section 7.)

NOTE

The instrument must be mounted in an approximately level position for proper operation.

A. Flush or Panel Mounting (Model 227)

1. Cut opening in panel and drill 4 holes per the dimension drawing (see Section 7).
2. Pass the instrument through the cut-out in the panel from the front of the panel.
3. Attach the indicator to the panel with 4 screws.

B. Wall Mounting (Model 227)

1. Remove the pipe mounting plate from the bracket (refer to Dwg., Page 7-3).
2. Drill 4 holes in the wall to match the bracket holes depicted in the applicable dimension drawing.
3. Attach the indicator with bolts and nuts.

C. **Pipe Mounting** (Model 227)

Refer to the Appendix and the applicable dimension drawing (Page 7-3) for pipe mounting instructions.

D. **Mounting** (Model 247)

The case of the Model 247 D.P. Indicator is provided with a hook located inside of the case, for hanging the instrument in a vertical position.

SECTION 4

OPERATION

4-1. START-UP

Instructions pertaining to DPU start-up and operation procedures are presented in the Appendix.

SECTION 5

MAINTENANCE AND CALIBRATION

5-1. DPU INSPECTION AND CLEANING

Instructions pertaining to DPU inspection and cleaning procedures are presented in the Appendix.

5-2. TOOLS REQUIRED FOR MAINTENANCE

The following tools will be required for the purpose shown during calibration or maintenance.

Equipment	Purpose
Pointer Puller (Item 25, Table 6-1)	Pointer Removal
Small Screwdriver	Calibration Adjustments
Medium Screwdriver	Bezel Removal and Replacement
⅛″ Open End Wrench	Calibration Adjustments
50 lb. Torque Wrench	Pressure Housing Bolts
3/16″ Allen Socket Wrench	Pressure Housing Bolts
5/16″ Allen Socket Wrench	Pressure Housing Bolts
Calibration Kit (Item 24, Table 6-1)	

5-3. RANGE CHANGES

To change the range of the Model 224 DPU, it is necessary to replace the BUA with a unit of the desired range. Replacement assemblies, range descriptions, and general range changing instructions are presented in the Appendix.

5-4. BELLOWS UNIT ASSEMBLY REPLACEMENT

CAUTION

DO NOT LOOSEN THE TWO PLUGS LOCATED ON THE BUA CENTER PLATE, WHEN REMOVING THE MOUNTING BRACKET. TO DO SO WILL CAUSE LOSS OF BELLOWS FILL FLUID AND RENDER THE UNIT INOPERABLE.

Before changing the BUA or calibrating the instrument, remove the lens, scale plate, and pointer as described below:

A. **Lens and Scale Plate Removal of Models 227 and 247** (Refer to Figure 6-1 to identify the parenthetical numbers used in the following text.)

1. Loosen the three bezel retainer screws (20) located on the front of the bezel.
2. Tilt out the bottom of the bezel assembly (18) and slide the bezel assembly up to disengage upper bezel retaining stud (21) to allow removal of the bezel assembly.
3. Remove the indicating pointer (12), using a pointer puller.
4. Remove the scale screws (13) and the scale plate (10). Disassembly at this point allows full access to all indicator movement and adjustments. Disassembly at this point allows full access to all indicator movement and adjustments.

B. **Bellows Unit Replacement** (Refer to Figure 6-1)

To replace the DPU Bellows Unit Assembly, proceed as follows:

1. Loosen and remove the movement follower arm (6).
2. Remove the indicator movement mounting screw (3) and washers (4 & 22), loosen zero eccentric support screws (9), and slide the indicator movement (2) free of the zero eccentric stem.
3. Remove the four Allen head DPU retaining screws (1), and separate the DPU from the indicator case.
4. Remove the DPU mounting bracket, pressure housing screws, and pressure housings.
5. Reassemble the DPU, using the replacement BUA and following steps 1 through 4 in reverse order.
6. Calibrate the instrument as outlined in Paragraph 5-6.

5-5. CALIBRATION CHECK

Normally all that is required to adjust the indicator to the factory-set calibration tolerances is to perform the following calibration check.

1. Connect the instrument to a standard pressure source as shown in the Appendix.
2. Remove the plug from the low-pressure housing.
3. Apply 0, 50%, and 100% of full scale pressure. If the indication is within the specified limits, no further adjustments are necessary.
4. If the zero indication is incorrect, remove the bezel and/or the glass assembly, and adjust the pointer by turning the zero eccentric stem (7).
5. Replace the lens and scale plate as outlined in Paragraphs 5-4.A. or B., whichever is applicable.

5-6. COMPLETE CALIBRATION

A complete calibration of the instrument is required whenever the DPU assembly is replaced. Refer to Figures 2-1, 6-1, 6-2, and the Appendix while performing the calibration procedure.

1. Connect the instrument to a standard pressure source as shown in the Appendix.

2. Vent the low-pressure housing to atmosphere by removing one plug from the housing.

3. Check the indicator: all bearings and pivots should be free of dirt and should not have excessive end play. All screws and nuts should be properly tightened.

4. At zero pressure, the indicator range adjust screw should be aligned vertically (see Figure 2-1) with the pointer shaft and torque tube shaft. If necessary, loosen the follower arm/torque tube shaft screw and move the follower arm to place the range screw in the correct position. Tighten the follower arm screw, being careful not to bend the torque tube shaft.

5. Install a calibration scale ring in the indicator, and replace the pointer, setting the pointer at zero.

6. Note the pointer deflection while rotating the zero adjust screw one full turn in both directions. Set the zero adjust screw to the midpoint of the deflection.

7. Remove and position the pointer at exact zero.

8. Apply 50% differential pressure, alternately, to the high- and low-pressure housings. Apply the 150% overrange pressure at least five times to each pressure housing.

9. Release all pressure to the pressure housings and reposition the pointer at zero.

10. Apply 100% differential pressure range. Observe pointer indication.

    If the pointer indicates less than 100% differential pressure, turn the range adjust screw clockwise.

    If the pointer indicates more than 100% differential pressure, turn the range adjust screw counterclockwise.

11. Repeat step 11 until the pointer indicates zero and 100%, respectively.

12. Apply 50% pressure, and observe pointer indication.

    If the pointer indication is high, insert a screwdriver into the *upper slot* of the follower arm and by gently twisting the screwdriver, spread the ends of the slot apart.

    If the pointer indication is low, spread the ends of the *lower slot* in the follower arm.

13. Check the pointer indication at 0 and 100% differential pressure. Repeat steps 10 through 12 until the desired accuracy is obtained.

14. Check the pointer indication at 25% and 75% pressure.

15. Remove the pointer and the calibration scale ring.

16. Reassemble the lens and scale components in the reverse order of the applicable sections of Paragraph 5-4.

NOTE

When replacing the pointer, place it as close as possible to zero.

5-7. TROUBLESHOOTING

If operating problems are encountered with the D.P. Indicator, refer to the Troubleshooting Chart, Table 5-1.

Table 5-1. Troubleshooting Chart

Problem	Probable Location	Possible Cause	Corrective Action
Low or No Indication	DPU	See Troubleshooting Chart in the Appendix	
	Indicator	Loose movement. Out of calibration. Pointer loose. Dirt in mechanism.	Tighten or replace. Calibrate. Tighten pointer. Clean mechanism.
	Piping or Primary Source	See Troubleshooting Chart in the Appendix.	
High Indication	Piping or Primary Source	See Troubleshooting Chart in the Appendix.	
	DPU	See Troubleshooting Chart in the Appendix.	
	Indicator	Loose arms or mechanism. Out of calibration.	Tighten mechanism. Calibrate.
Erratic Indication	Primary Element	See Troubleshooting Chart in the Appendix.	
	Piping	See Troubleshooting Chart in the Appendix.	
	DPU	See Troubleshooting Chart in the Appendix.	
	Indicator	Movement dragging or dirty. Pointer dragging on scale plate.	Adjust or clean movement. Adjust pointer position.

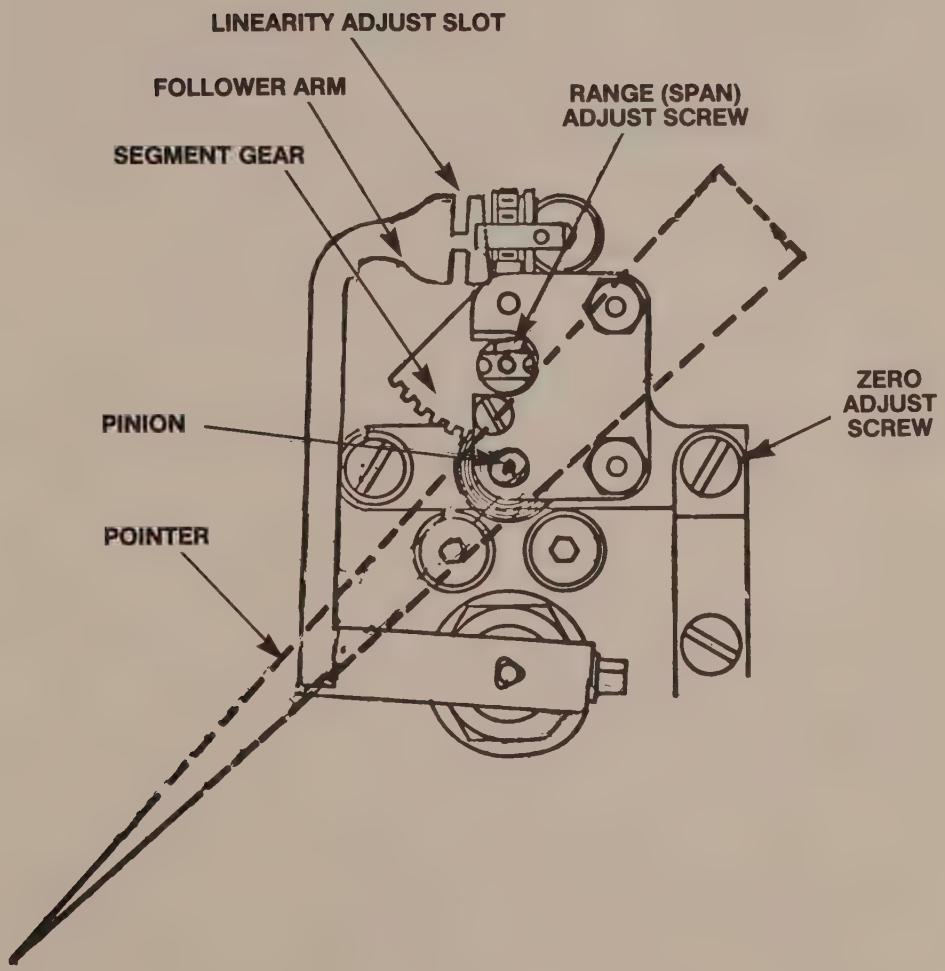


Figure 5-1. Indicator Mechanism

SECTION 6

PARTS LISTS

6-1. GENERAL

The parts list and parts identification for the Model 224 Differential Pressure Unit are presented in the Appendix.

The common component parts for the Model 227 and 247 D.P. Indicator mechanisms are identified in Figure 6-1 and listed in Table 6-1.

The portable piping and additional component parts for the Model 247 Indicator are identified in Figure 6-2 and listed in Table 6-2.

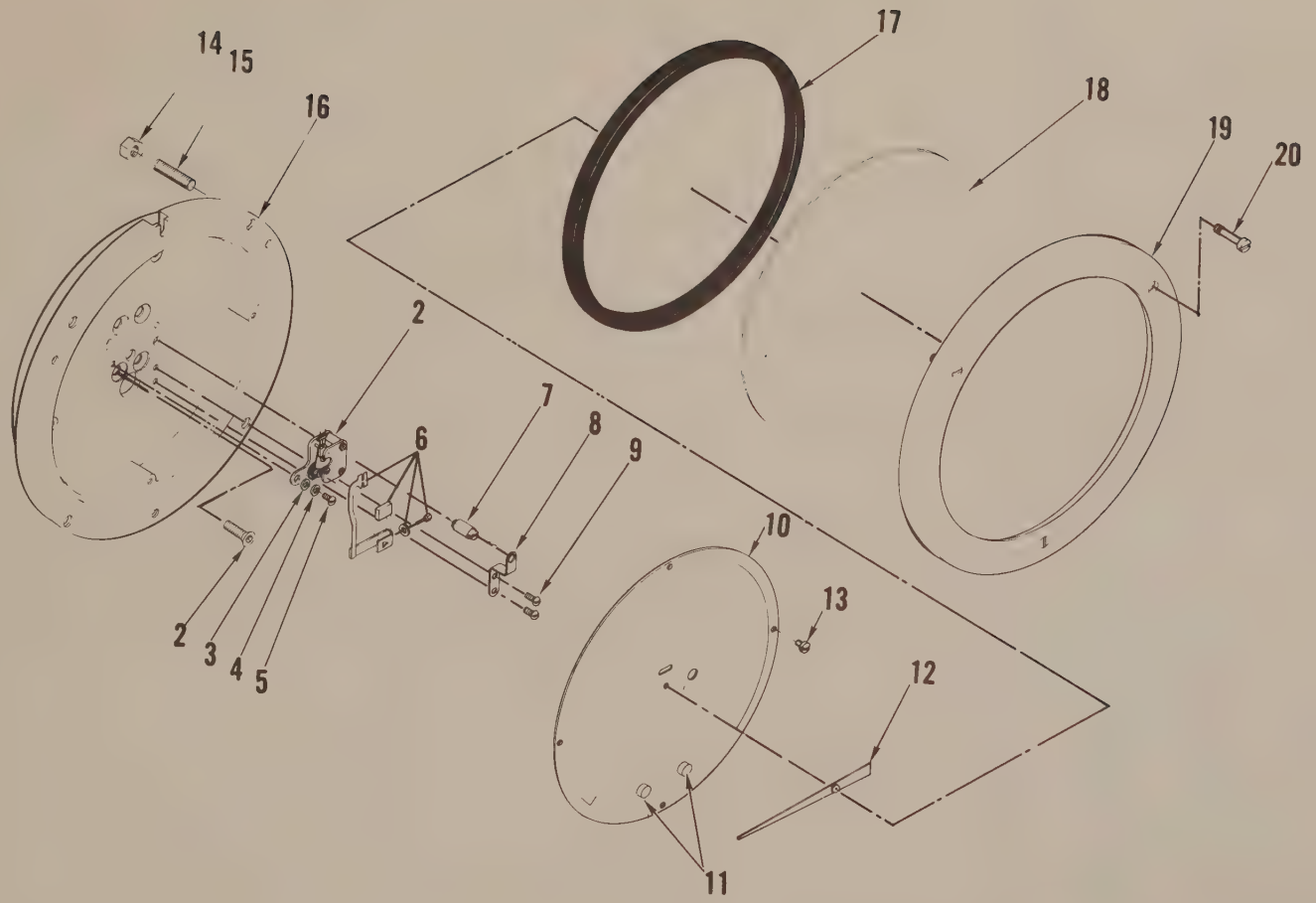


Figure 6-2. Models 227/247 Indicator Assembly

Table 6-1. Parts List, Models 227/247 Indicator Assembly

Item	Description	Part No.	Per Unit
	For the Model 224 Differential Pressure Unit, See the Appendix		
1	A. Screw, 6-32 x 7/16″, Steel CP (See Note 2) (Not Shown in drawing)	0240.0007.J	6
2	Movement	0226.0001.B	1
3	Screw, Movement Mounting, 4-40 x ¼″, Stainless Steel	0111.0034.J	1
4	Washer, Lock, Movement Mounting, 4-40 Steel, NP	0003.0007.K	1
5	Washer, Flat, 4-40	0003.0008.K	1
6	Arm, Movement Follower	0226.0002.B	1
7	Stem, Zero Eccentric	0226.0001.C	1
8	Support, Zero Eccentric Stem	0226.0002.C	1
9	Screw, Support, 4-40 x 3/16″, Stainless Steel	0111.0047.J	2
10	Plate, Scale (See Note 3)	0227.0008.C	1
11	Snubber, Pointer	0226.0028.C	2
*12	Pointer, White	0181.0012.B	1
13	Screw, Scale, 4-40 x 3/16″, Stainless Steel	0114.0023.J	4
14	Nut, Case Mounting, ¼-20, Steel, CP	0500.0010.J	4
15	Stud, Case Mounting, ¼-20 x 1″, Steel, CP	0340.0003.J	4
16	Case, Universal Mounting	0227.0010.C	1
*17	Gasket, Bezel	0277.0026.C	1
*18	Lens:		1
	Glass	0181.0005.C	
	Lucite	0181.0038.C	
19	Bezel Assembly:		1
	Glass Lens	0277.0016.B	
	Lucite Lens	0277.0018.B	
20	Screw, Bezel Retainer	0181.0007.C	3
21	Stud, Upper Bezel Retaining (Part of Item 19) (Not Shown in drawing)	0004.0005.K	1
22	Washer, Movement, Lock, 4-40 Steel, NP (Used with Items 6 & 7)	0003.0007.K	2
23	Scale, Calibration with center cut-out for access to adjustments. Graduations are 0-100 unif. and 0-10 sq.rt. (Not Shown in drawing).	0200.0047.C	1
*24	Kit, Calibration (Not Shown, includes Pointer Puller)	0288.1032.B	1
*25	Puller, Pointer (Not Shown)	0163.0005.B	1

Table 6-1. Parts List, Models 227/247 Indicator Assembly (Cont)

NOTES:

* Indicates recommended spare parts.

1. When ordering parts, please specify serial number of instrument with which they are to be used.

2. For units manufactured prior to 1968, order 6 screws 10-32 x ½" Stainless Steel, Part Number 0240.0015.J. Horizontal distance between these screws is 19/32".

3. **Scale Plate Identification:**
   If the scale plate shows an "SCR" number, this will identify it. Otherwise, give the following information:
   (a) Square root or linear graduation.
   (b) Scale, e.g., 0-100, 24-0-100, etc.
   (c) Number of graduations (linear scales only).
   (d) Data, e.g., "PSI," "Inches of Water Column," etc.
   (e) Standard plates have black background.

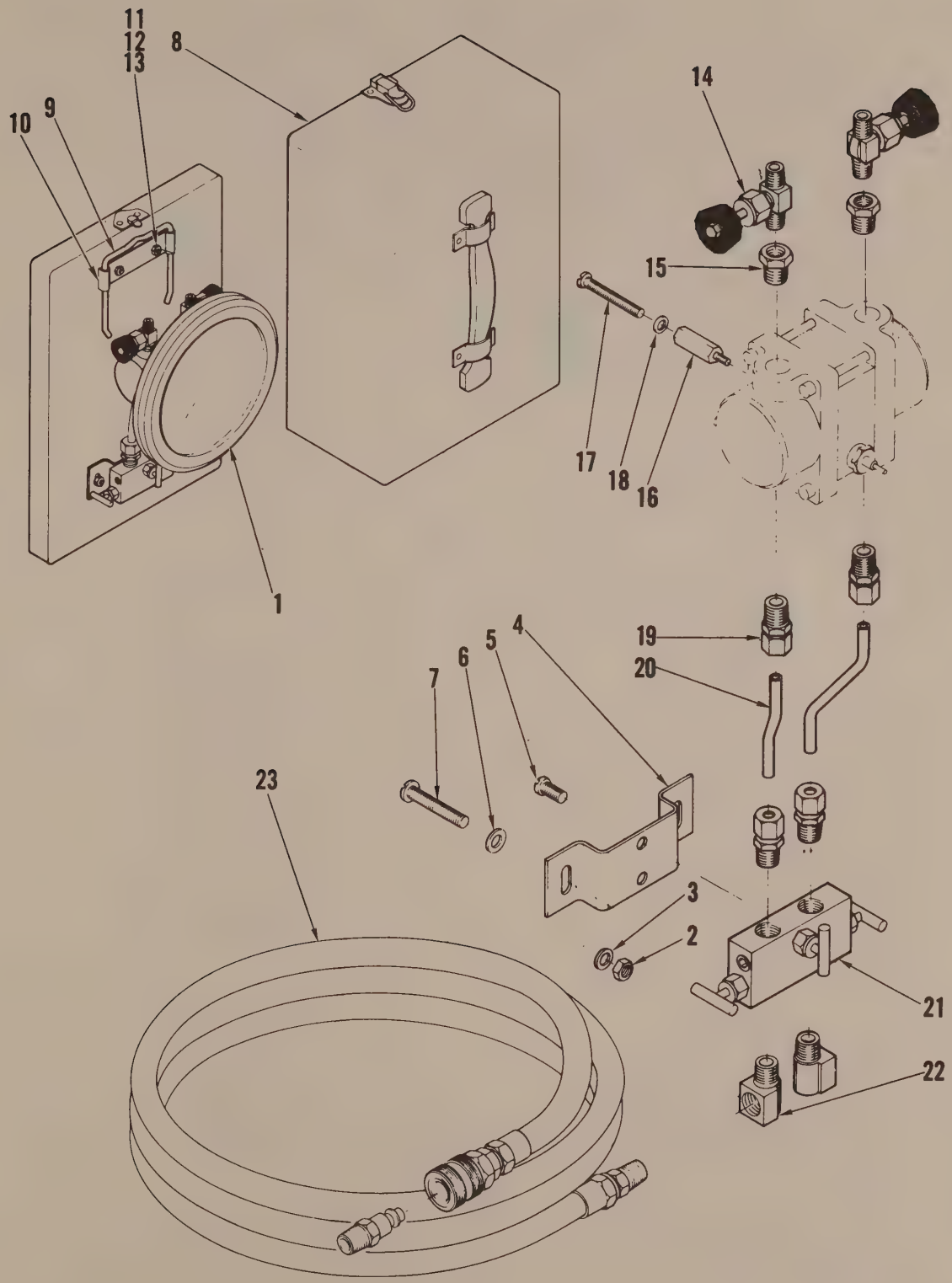


Figure 6-2. Model 247 Differential Pressure Indicator Parts Identification

Table 6-2. Parts List, Model 247 D.P. Indicator

Item	Description	Part No.	Per Unit
	For the Model 224 Differential Pressure Unit, See the Appendix		
1	Indicator Assembly (Refer to Table 6-1 and Figure 6-1 for parts breakdown)	—	1
2	Nut, Bracket Mounting	0500.0011.J	2
3	Washer, Bracket Mounting	0003.0013.K	2
4	Bracket, Manifold	0224.0059.C	1
5	Screw, Manifold Mounting	0114.0084.J	2
6	Washer, Bracket Mounting	0003.0018.K	2
7	Screw, Bracket Mounting	0111.0036.J	2
8	Assembly, Carrying Case	0224.0433.B	1
9	Handle	0246.0001.C	1
10	Bracket, Handle	0246.0002.C	1
11	Nut, Handle Mounting	0500.0011.J	2
12	Screw, Handle Mounting	0111.0036.J	2
13	Washer	0003.0013.K	2
14	Valve, Globe:		2
	Brass	0001.0008.Q	
	Stainless Steel	0001.0009.Q	
15	Bushing, Pipe:		2
	Brass	0902.0002.L	
	Stainless Steel	0902.0001.L	
16	Standoff	0152.0019.T	4
17	Screw, Instrument Mounting	0111.0060.J	4
18	Washer	0003.0029.K	4
19	Connector, Tube:		4
	Brass	0502.0002.M	
	Steel	0504.0001.M	
	Stainless Steel	0505.0008.M	
20	Tubing, Manifold:		2
	Brass	0235.0001.C	
	Stainless Steel	0235.1001.C	
21	Manifold:		1
	Brass	0001.0014.Q	
	Steel	0001.0015.Q	
	Stainless Steel	0001.0016.Q	
22	Elbow	0102.0008.L	2
23	Assembly, Neoprene Hose	0074.0002.T	2
24	Nameplate, Instruction (Not Shown on drawing)	0226.0001.G	1

NOTE:

When ordering parts, please specify serial number of the instrument with which they are to be used.

SECTION 7

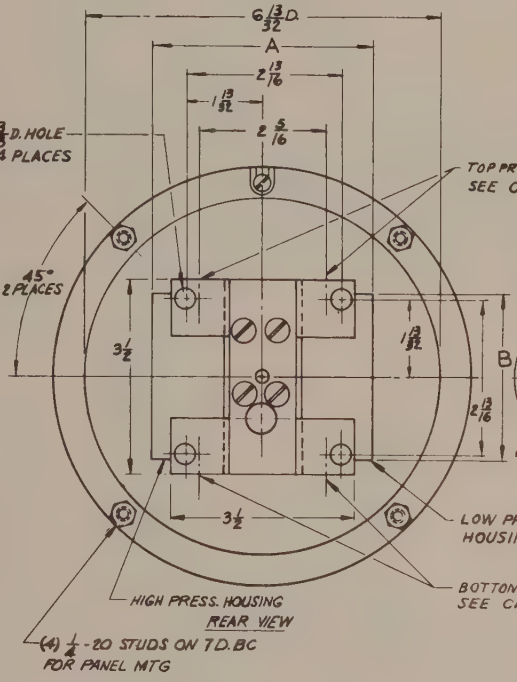
DRAWINGS

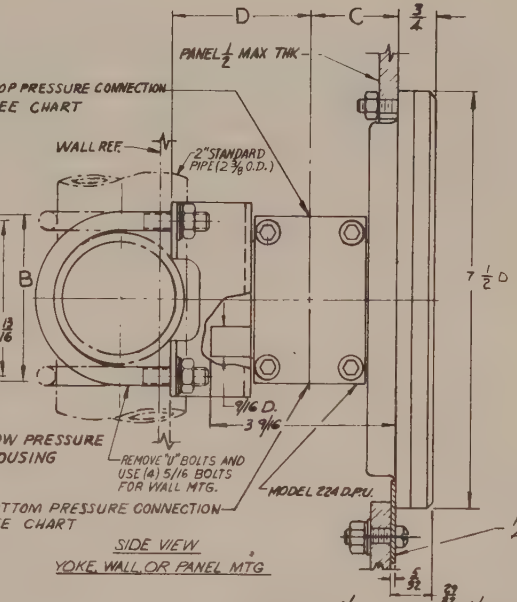
7-1. OUTLINE DIMENSION DRAWINGS

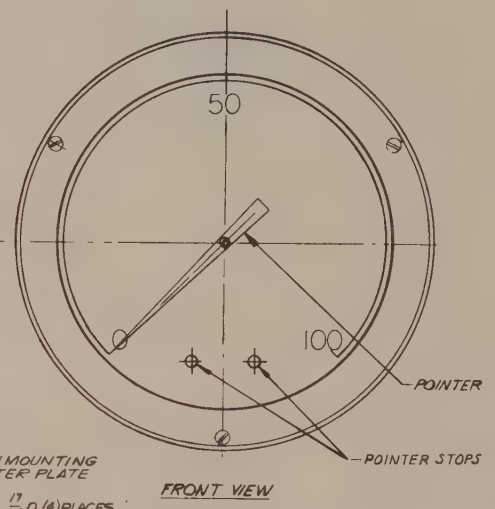
The latest revision of the following outline dimension drawings are presented in this section:

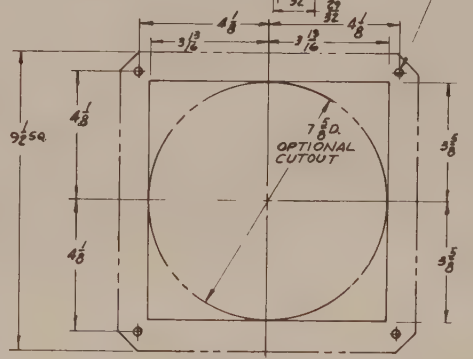
0227.0901.3
0227.0902.3
0227.0903.3
D3-247-901 (0247.0901.3)

ITT BARTON

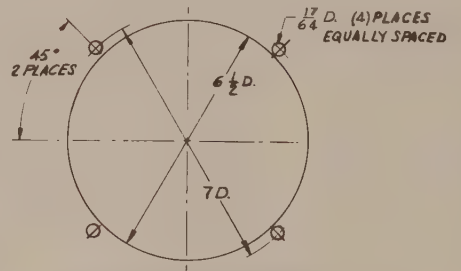








PANEL CUTOUTS
FLUSH MTG. ADAPTER



PANEL MOUNTING CUTOUT

2. ⊕ CAN BE REVERSED WHEN ORDERED OR CAN BE ROTATED 180° IN THE FIELD.
1. ⊖ SUITABLE FOR USE WITH AMINCO FITTINGS OR EQUIV. (AMERICAN INST. CO. SILVER SPRINGS, MD.)

NOTES.

PRESSURE RATING	HOUSING MATERIAL	TOP PRESSURE CONNECTIONS	BOTTOM PRESSURE CONNECTIONS	A	B	C	D
10 000 PSI	E4140 ALLOY ST.	1/4 ANPT ⊖ 9/16-18 UNF	1/4 ANPT ⊖ 9/16-18 UNF	4 3/8	3 1/4	1 51/64	2 3/4
6000 PSI	316 ST. ST.	⊕ 1/2 ANPT ⊖ 9/16-18 UNF	⊕ 1/4 ANPT ⊖ 9/16-18 UNF				
	CR. ST. C1018	⊕ 1/2 ANPT ⊖ 9/16-18 UNF	⊕ 1/4 ANPT ⊖ 9/16-18 UNF				
3000 PSI	316 ST. ST.	⊕ 1/2 ANPT	⊕ 1/4 ANPT	4 1/8			
	CR. ST. C1018	⊕ 1/2 ANPT	⊕ 1/4 ANPT				
1500 PSI	316 ST. ST.	1/4 ANPT	1/4 ANPT	4	2 15/16	1 43/64	2 5/8
	CR. ST. C1018						
1000 PSI	BRASS BAR FED. SPEC. QQ-B-637	1/8 ANPT	1/8 ANPT				

NO	CHANGE	DATE	BY	APP
12	INCORPORATED RPR 7040	5-14-71	JBV	
11	INCORPORATED CR3242	10-16-2	APL	YNL
10	INCORPORATED CR 3092	9-25-68	MM	YNL
9	REVISED & REDRAWN	2-27-68	MM	YNL

BARTON INSTRUMENT CORPORATION MONTEREY PARK, CALIF. U.S.A. SUBSIDIARY OF ITT

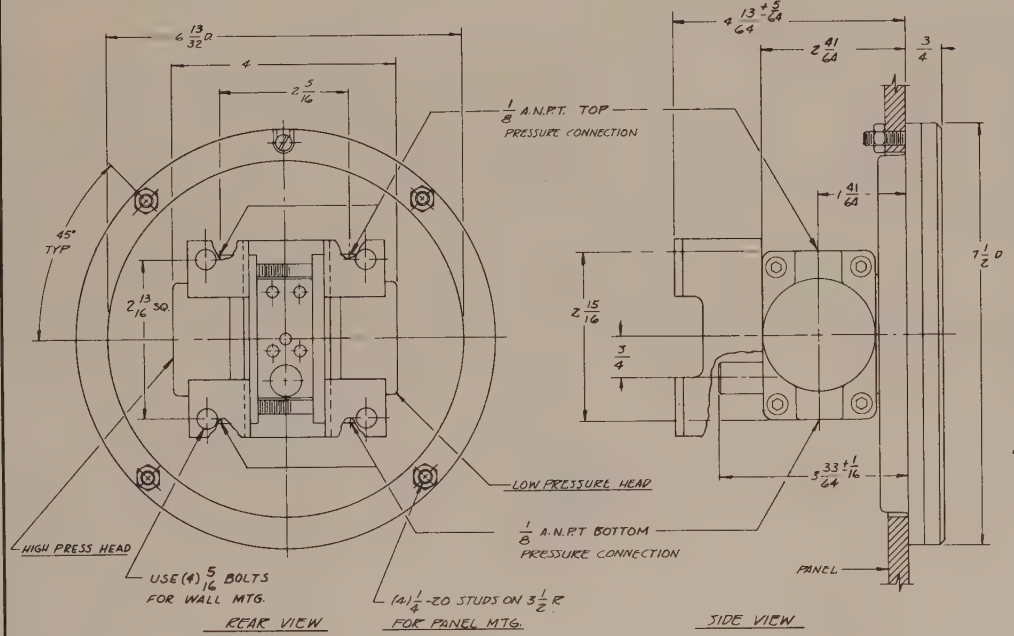
MAT'L | SIZE | FINISH

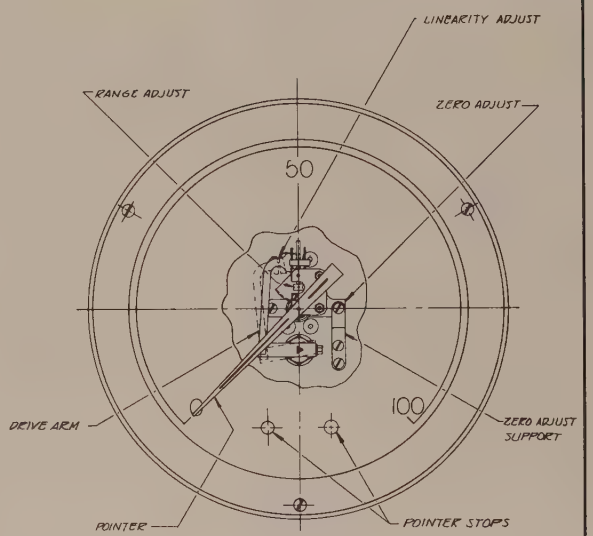
LIMITS ON DIMENSIONS UNLESS OTHERWISE NOTED
DECIMAL ± .003
ANGULAR ± 1/2°
FRACTIONAL ± 1/64
CONCEN WITHIN .002

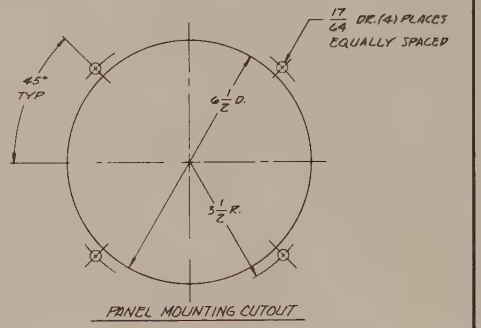
SCALE NONE
DATE 27 FEB 68
DRAWN N. EAD
CHECKED MM
APPR YNL

OUTLINE DIM MOD. 227 & 227A DIFF PRESS IND. YOKE, WALL OR PANEL MTG

SUPERSEDES | SUPERSEDED | DWG. 0227-0901-3 | 012







NO.	CHANGE	DATE	BY	APP.
5	INT REACTIVATED	8-23-71	RT	WL
4	DIMS, TOLER. & BRACKET REVISED	5-18-65	H.P.	
3	REDRAWN	8-26-63	R.M.	

BARTON INSTRUMENT CORP.
MONTEREY PARK, CALIF.

MAT'L	
SIZE	
FINISH	

LIMITS ON DIMENSIONS UNLESS OTHERWISE NOTED
DECIMAL ± .003
ANGULAR ± 1/2°
FRACTIONAL ± 1/32
CONCEN. WITHIN .005

SCALE	NONE
DATE	8-26-63
DRAWN	NAGANO
CHECKED	
APPR	

OUTLINE DIM. MODEL 227 DIFF. PRESS. INDICATOR UNIV. MTG. 400 P.S.I. ALUM.

SUPERSEDED 01-227-703-4

SUPERSEDED

DWG. 0227-0902-3 005

FORM 02-18 1000 8-61

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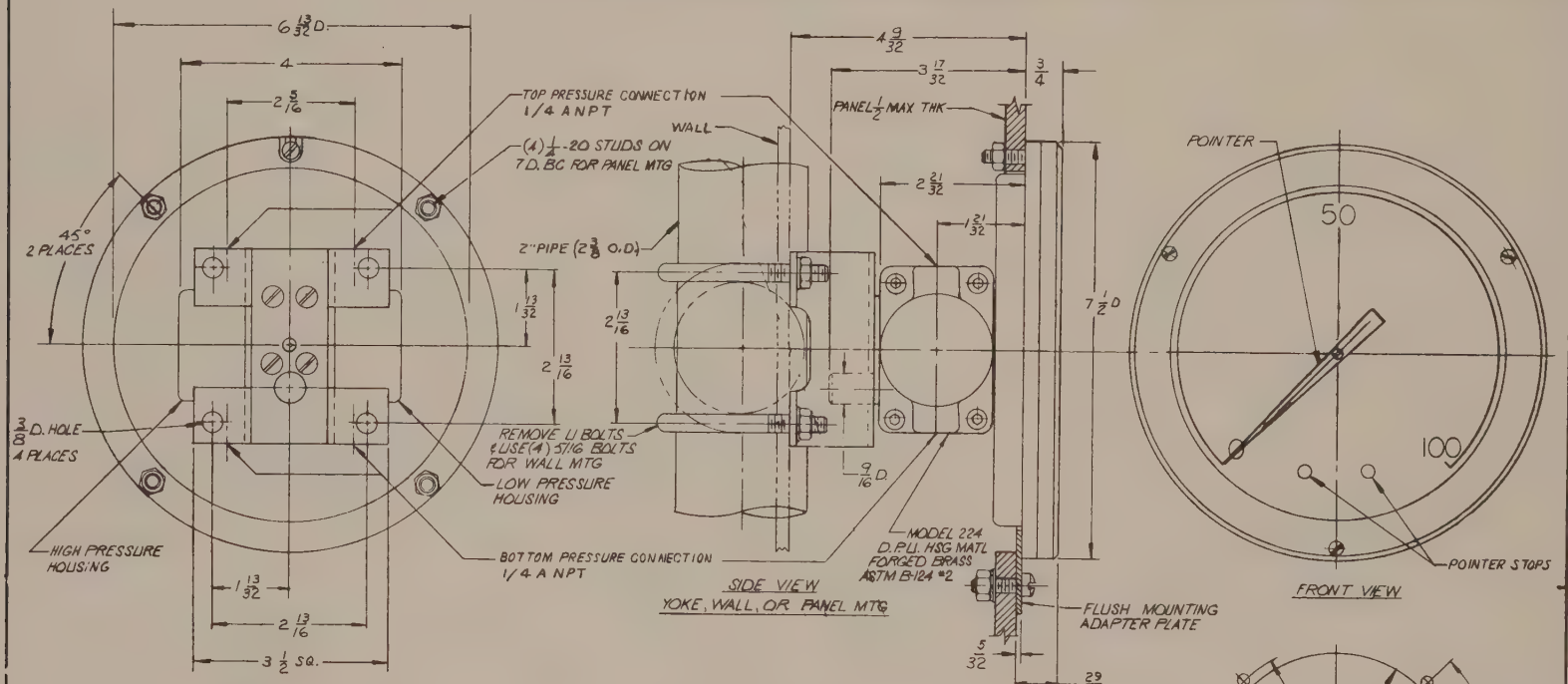
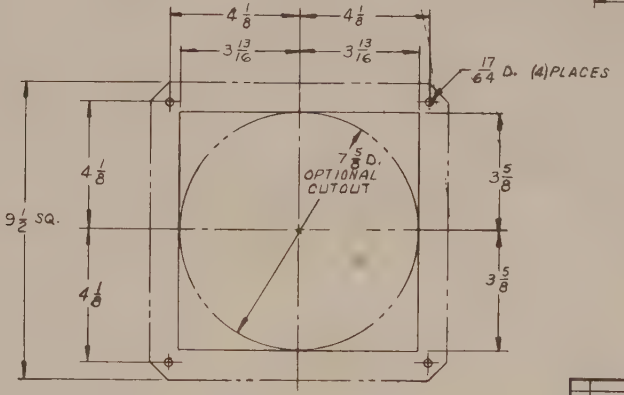


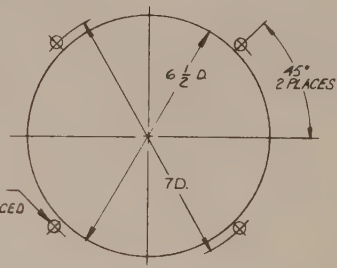
REAR VIEW

SIDE VIEW
YOKE, WALL, OR PANEL MTG

FRONT VIEW



PANEL CUTOUTS
FLUSH MTG. ADAPTER PLATE



PANEL MOUNTING CUTOUT

NO.	CHANGE	DATE	BY	APP.
7	INCORPORATED RPR 7040	5-14-71	[illegible]	
6	INCORPORATED CP 3542	10-28-68	WM	V.N.L
5	REVISED & REDRAWN	2-28-68	[illegible]	V.N.L

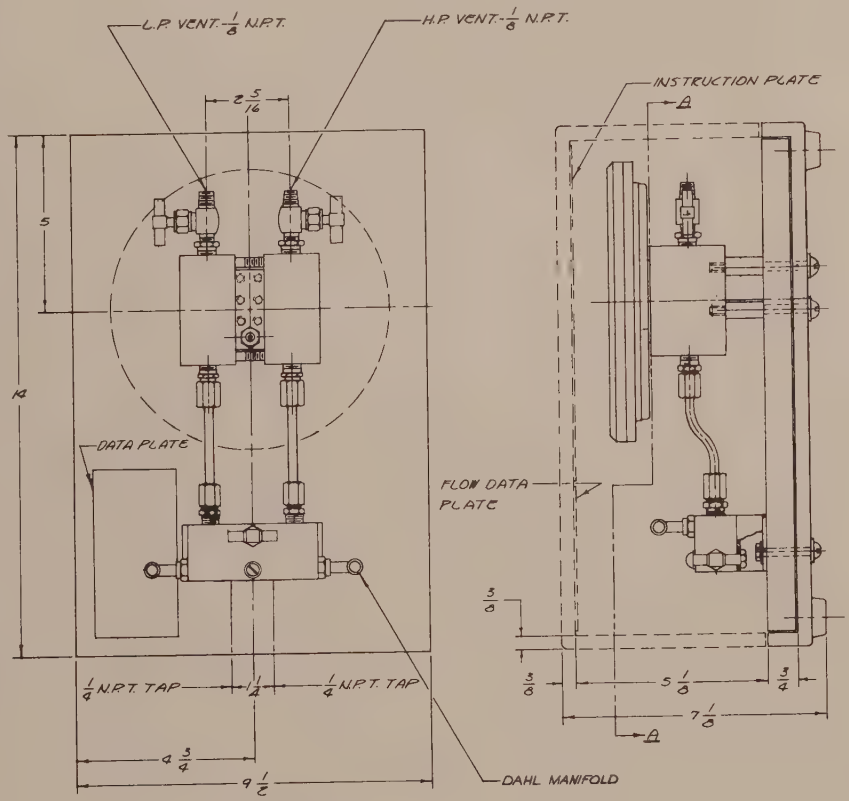
MAT'L
SIZE
FINISH
LIMITS ON DIMENSIONS UNLESS OTHERWISE NOTED
DECIMAL ± .005
ANGULAR ± 1/2°
FRACTIONAL ± 1/64
CONCEN. WITHIN .005

SCALE NONE
DATE 22 FEB 68
DRAWN M.GAD
CHECKED V.N.L
APPD. V.N.L

OUTLINE DIM MOD 227 & 227A DIFF. PRESS IND. YOKE, WALL OR PANEL MTG 500 PSI FORGED BRASS

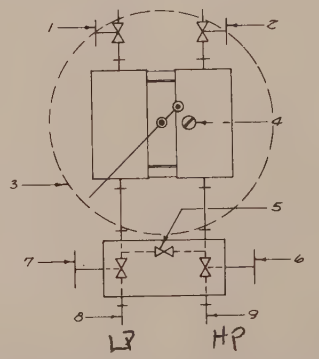
BARTON INSTRUMENT CORPORATION A SUBSIDIARY OF ITT

DWG. 02 27-0903-3 001



SECTION AA

INSTRUCTIONS



1 PLACE INSTRUMENT WITH DIAL FACE LEVEL. OPEN VALVES (1) & (2). POINTER SHOULD READ ZERO. IF IT DOES NOT, REMOVE BEZEL ASSEMBLY (3). TURN SCREW (4) UNTIL POINTER READS ZERO. REPLACE BEZEL ASSEMBLY.

2 CLOSE VALVES (1) & (2). OPEN VALVE (5) CLOSE VALVES (6) & (7).

3 CONNECT HIGH PRESSURE FITTING (9) TO UPSTREAM ORIFICE TAP & CONNECT LOW PRESSURE FITTING (8) TO DOWNSTREAM ORIFICE TAP USING RUBBER HOSES PROVIDED.

4 OPEN VALVES AT ORIFICE

5 OPEN VALVES (6) & (7) AND CRACK VALVES (1) & (2) UNTIL ALL AIR HAS BEEN EXPELLED FROM THE INSTRUMENT & HOSES

6 CLOSE VALVES (1), (2), (6) & (7), KEEPING VALVE (5) OPEN, POINTER SHOULD THEN INDICATE ZERO. IF IT DOES NOT, AIR IS TRAPPED IN THE SYSTEM. REPEAT STEP (5), OPENING VALVES (6) & (7) ALTERNATELY UNTIL ALL AIR IS REMOVED.

7 OPEN VALVES (6) & (7), CLOSE VALVE (5) & READ PRESSURE DIFFERENTIAL.

8 WHEN THROUGH WITH TEST, OPEN VALVE (5), CLOSE VALVES AT ORIFICE AND REMOVE HOSES

9 OPEN VALVE (1) & (2), AND DRAIN INSTRUMENT & HOSES

ITT BARTON
MONTEREY PARK, CALIFORNIA

		MAT'L	LIMITS ON DIMENSIONS UNLESS OTHERWISE NOTED	SCALE NONE
		SIZE	DECIMAL ± .005 ANGULAR ± 1/2° FRACTIONAL ± 1/32 CONCEN. WITHIN .005	DATE 2-20-69
		FINISH		DRAWN MM
				CHECKED
				APPR
NO.	CHANGE	DATE	BY	APP.
1	4018 DAHL PUR DEPT	3-25-71	MM	

BARTON INSTRUMENT CORP.
MONTEREY PARK, CALIF.

OUTLINE DIM. P247 DIFFERENTIAL PRESS.
PORTABLE INDICATOR-NAVY

DWG. D3-247-901-3

APPENDIX

MODEL 224 DIFFERENTIAL PRESSURE UNIT

WARRANTY

The warranty of the Differential Pressure Unit will be voided if the following limitations are exceeded:

TEMPERATURE: Do not subject the DPU to temperature above 200°F or below -60°F (35°F minimum for water filled units).

PRESSURE: Do not subject the DPU to operating pressure in excess of the working pressure rating stamped on the housing of the unit.

CORROSION: Do not subject the DPU to incompatible process media.

SEALED COMPONENTS: Do not loosen or remove the torque tube gland nut, the drive arm hole plug, or the torque tube housing from the center plate (see Figures 1-2 and 1-3 of Appendix). To do so will cause loss of fill fluid.

VIBRATION: Do not subject the DPU to severe mechanical vibration.

SHOCK: Do not subject the DPU to hydraulic shock.

PULSATION: Do not subject the DPU to severe pulsation.

SAFETY

Before installing the instrument, become familiar with the installation instructions presented in Section 3.

WARNING notes call attention to potential hazards or operating procedures which, if not correctly followed, could cause personal injury or death.

CAUTION notes call attention to procedures which, if not strictly observed, could cause damage to, or destruction of, the equipment.

WARNINGS and/or **CAUTIONS** appear on the following pages of this manual and should be reviewed before proceeding: A-15, A-16, A-17, A-19, A-20, A-21, A-22, A-24, A-25, A-26, and A-30.

Manual No. 82E3

INSTALLATION AND OPERATION MANUAL

MODEL 224
DIFFERENTIAL PRESSURE UNIT

ITT BARTON INSTRUMENTS
P.O. Box 1882
900 S. Turnbull Canyon Road
City of Industry, CA 91749

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RECORD OF CHANGES

CHANGE NO.	DATE	DESCRIPTION	ENTERED BY
80K2-1	9/1/81	New issue.	D. Edmiston
82E3	5/5/82	Revision to integrate all material into one manual.	D. Evans

TABLE OF CONTENTS

SECTION	TITLE	PAGE
1	INTRODUCTION	A-7
	1-1. General	A-7
	1-2. Product Description	A-7
	1-3. Specifications	A-7
2	THEORY OF OPERATION	A-13
	2-1. Basic Components	A-13
	2-2. Basic Operation	A-14
3	INSTALLATION	A-15
	3-1. Unpacking	A-15
	3-2. Mounting	A-15
	3-3. Piping — Standard Practice	A-15
	3-4. Piping for Flow Applications	A-16
4	OPERATION	A-23
	4-1. Startup Procedure	A-23
	4-2. General Practice Considerations	A-23
5	CALIBRATION AND SERVICING	A-25
	5-1. Calibration	A-25
	5-2. Troubleshooting	A-25
	5-3. Servicing Tools	A-25
	5-4. Cleaning and Inspection	A-25
	5-5. Range Change	A-26
	5-6. Bellows Unit Assembly Replacement	A-26
6	PARTS LIST	A-31
	6-1. Parts List	A-31
	6-2. Component Identification	A-31
7	DRAWINGS	A-37
	7-1. Outline Dimension Drawings	A-37

LIST OF ILLUSTRATIONS

FIGURE		PAGE
1-1	Model 224 Differential Pressure Unit	A-8
1-2	Model 224 Differential Pressure Unit — Bellows Unit Assembly	A-9
1-3	Differential Pressure Unit — Cut Away View	A-11
1-4	Mechanical Operation	A-12
3-1	Gas Flow, DPU Above Run	A-18
3-2	Gas Flow, DPU Below Run	A-18
3-3	Gas Flow, Hydrates Present	A-18
3-4	Steam Flow, DPU Below Run	A-19
3-5	Liquid Flow, DPU Above Run	A-19
3-6	Liquid Flow, DPU Below Run	A-19
3-7	Corrosive Liquid Flow	A-20
3-8	Cool Non-Condensing Liquid DPU Level With Tank Bottom	A-20
3-9	Cool Non-Condensing Liquid DPU Below Tank	A-20
3-10	DPU Below Tank With Reference Leg	A-21
3-11	Liquid CO_2	A-21
3-12	Cryogenic Liquids	A-22
3-13	Bubbler System	A-22
3-14	Liquid Specific Gravity	A-22
5-1	Instrument Calibration Setup	A-27
6-1	Model 224 Differential Pressure Unit Parts Identification	A-32

LIST OF TABLES

TABLE		PAGE
1-1	General Specifications	A-10
5-1	Troubleshooting Chart	A-28
5-2	Torque Table	A-30
6-1	Parts List, Model 224 Differential Pressure Unit	A-33

SECTION 1

INTRODUCTION

1-1. GENERAL

The Barton ITT Model 224 Differential Pressure Unit (DPU) (Figure 1-1), is a mechanical device which accurately measures differential pressure relative to a gas or liquid flowing through a process system, or to the level of a liquid contained in a process vessel.

For process flow measurements, the Model 224 DPU is connected across a primary device (a venturi, an orifice plate, or a flow tube) located in the process system.

For liquid level measurements, the Model 224 DPU may be connected in a variety of ways to measure the difference in pressure caused by variations in the level of the liquid in the process vessel.

1-2. PRODUCT DESCRIPTION

The Model 224 DPU (Figure 1-2) is a dual bellows assembly enclosed within pressure housings. The dual bellows assembly consists of two opposing internally connected liquid-filled bellows, a center plate, range springs, overrange valves, and a torque tube assembly.

The pressure housings are connected by pipe or tubing to the primary device located in the system piping. Variations in differential pressure within the pressure housings cause the bellows to expand or contract in a linear direction towards the side having the lowest pressure.

The linear movement of the bellows is converted into angular rotation when transmitted to the torque tube shaft by the drive arm and this mechanical motion actuates the mechanism of the process monitoring instrument.

The process monitoring instrument that is connected to the torque tube assembly may be an indicator, a switch, a transmitter, a recorder, or other process control device.

1-3. SPECIFICATIONS

The Model 224 Differential Pressure Unit is available in various pressure ratings to measure in specific ranges between 0 to 30″ w.c. and 0 to 600 psi, with safe working pressure ratings of 400 to 10,000 psi.

The bellows unit assembly (BUA) of the Model 224 Differential Pressure Unit is produced in two bellows sizes: 1⅝-inch diameter and ¾-inch diameter (see Figure 1-2).

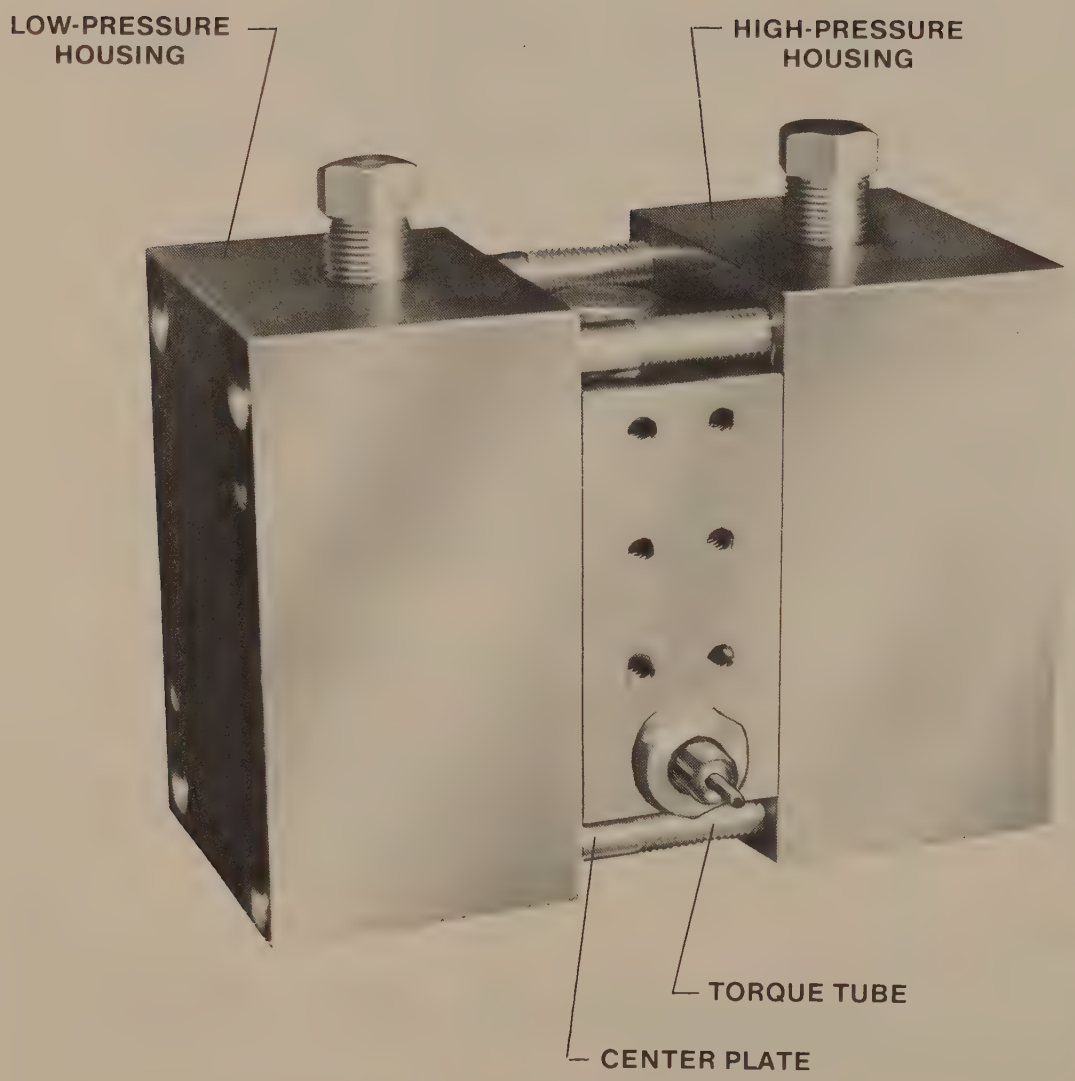
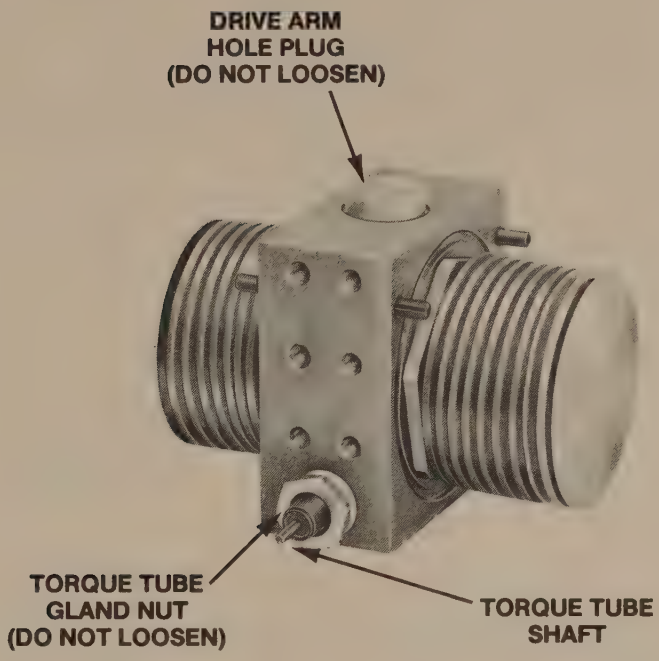
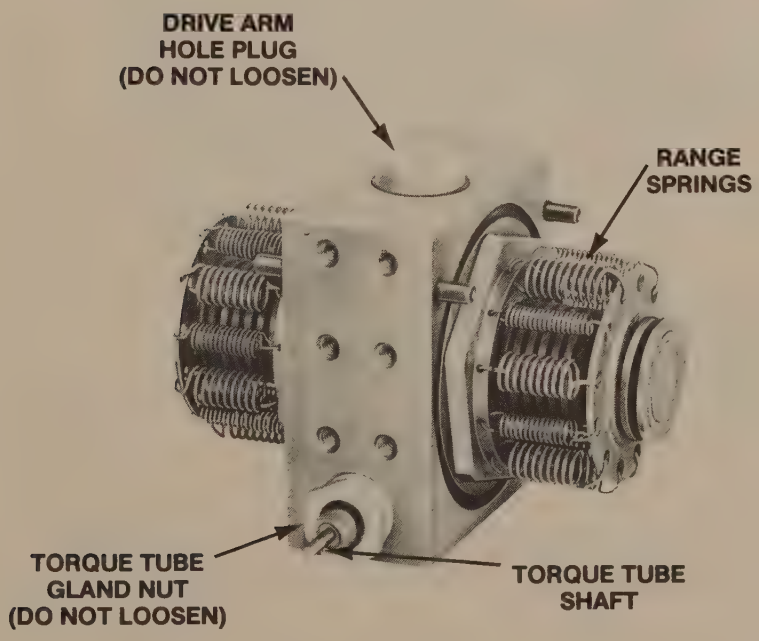


Figure 1-1. Model 224 Differential Pressure Unit



1⅝" BELLOWS UNIT ASSEMBLY



¾" BELLOWS UNIT ASSEMBLY

Figure 1-2. Model 224 Differential Pressure Unit — Bellows Unit Assembly

Table 1-1. General Specifications

Body		Available Differential Pressure Ranges				Pressure Connections	
		Stainless Steel Bellows		Beryllium Copper Bellows			
SWP — PSI	Housing Material	1⅝" O.D.	¾" O.D.	1⅝" O.D.	¾" O.D.	Top	Bottom
400	Cast Aluminum	0-30" w.c. to 0-55 psi	0-60 psi to 0-400 psi			⅛" NPT	⅛" NPT
500	Forged Brass (ASTM-B124#2)			0-30" w.c. to 0-24.5 psi	0-25 psi to 0-400 psi	¼" NPT	¼" NPT
500	Stainless Steel (316)	0-30" w.c. to 0-55 psi	0-60 psi to 0-500 psi			¼" NPT	¼" NPT
1,000	Brass (Fed. Spec. QQ-B-637 Comp. 2)			0-60" w.c. to 0-24.5 psi	0-25 psi to 0-400 psi	⅛" NPT ¼" NPT	⅛" NPT ¼" NPT
1,000	Copper Nickel (70-30) (MIL-C-15726)			0-60" w.c. to 0-25.5 psi	0-25 psi to 0-400 psi	MS 16142-4	MS 16142-4
1,500	Cold Rolled Steel (C1018) Stainless Steel (316)	0-60" w.c. to 0-55 psi	0-60 psi to 0-600 psi	0-60" w.c. to 0-24.5 psi	0-25 psi to 0-400 psi	¼" NPT	¼" NPT
3,000	Cold Rolled Steel (C1018) Stainless Steel (316)	0-60" w.c. to 0-55 psi	0-60 psi to 0-600 psi	0-60" w.c. to 0-24.5 psi	0-25 psi to 0-400 psi	½" NPT	¼" NPT
6,000	Cold Rolled Steel (C1018) Stainless Steel (316)	0-70" w.c. to 0-55 psi	0-60 psi to 0-600 psi	0-70" w.c. to 0-24.5 psi	0-25" psi to 0-400 psi	½" NPT 9/16"-18UNF-2B	¼" NPT 9/16"-18UNF-2B
10,000	Alloy Steel (4140)	0-100" w.c. to 0-55 psi	0-60 psi to 0-600 psi	0-100" w.c. to 0-24.5 psi	0-25 psi to 0-400 psi	9/16"-18UNF-2B	9/16"-18UNF-2B

Net Volume in cu.in.	L.P. Head	1.66	2.51	1.66	2.51	
	H.P. Head	1.55	2.42	1.55	2.42	
Displacement in cu.in. for full-scale travel		.14	.03	.14	.03	

NOTE: Zero center or split ranges are available on special order. For example, a 0-60" w.c. range may be ordered 30-0-30" w.c. or 15-0-45" w.c.
Absolute pressure ranges are available from 100" w.c. to 600 psi.
Other sizes and types of connections (welding stubs, MS, A.N.D., etc.) are available upon request.
Special bellows and housing materials can be made available such as Monel, Inconel 625 and Hastelloy-C upon request.
Outline dimensional drawings are available upon request.

Performance Specifications:

Torque Tube Rotations
(full-scale differential pressure) ..... 8° ± 10%

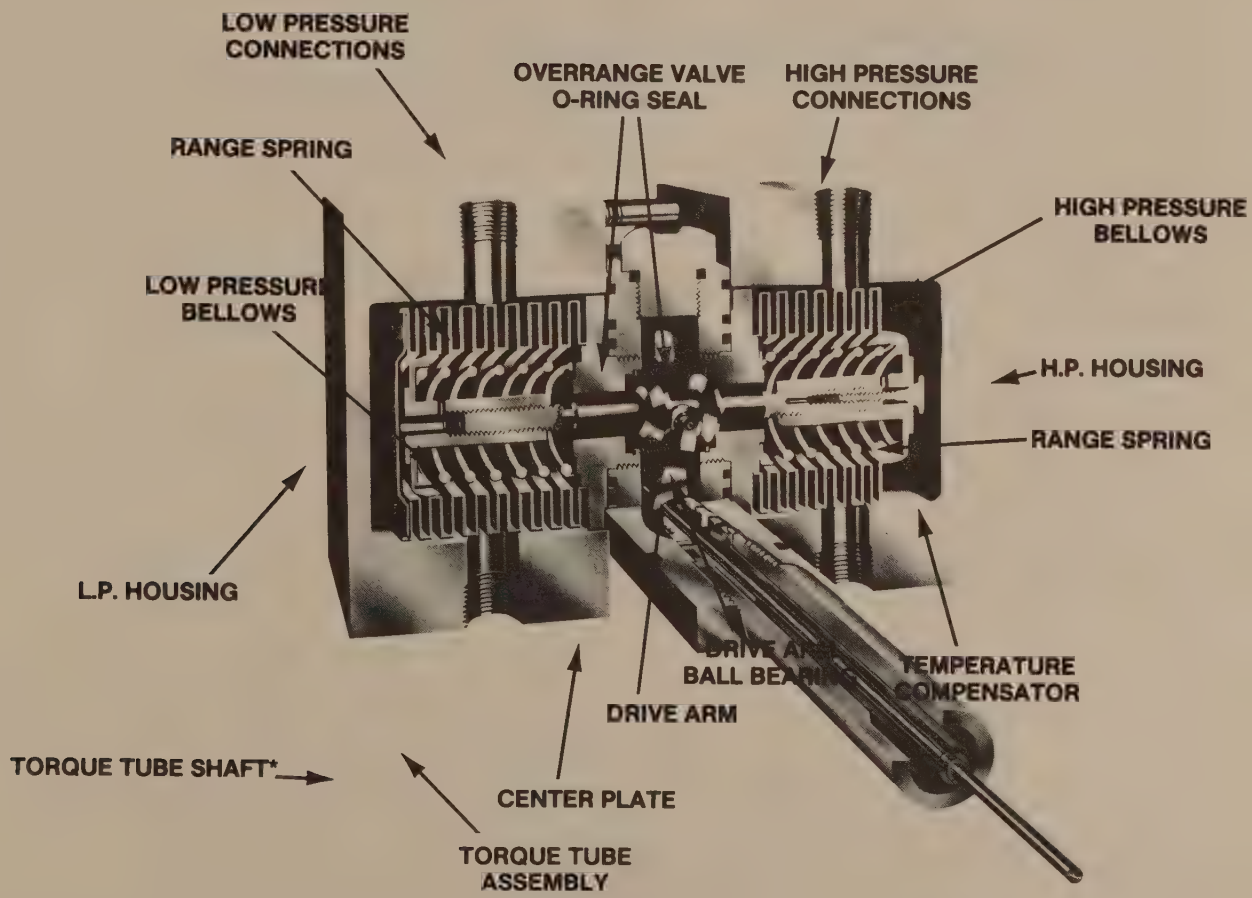
Temperature Limits..... -60° to +200°F

Maximum Non-Linearity 1.5%

The 1⅝-inch diameter BUA accommodates pressures of up to 55 psi. The range springs of this BUA are contained within the bellows and do not come in contact with the measured liquid.

The ¾-inch BUA accommodates pressures of up to 600 psi. The range springs of this BUA are grouped around the outside of the bellows, and must be of a material that is compatible with the liquid being measured.

The specifications for the Model 224 Differential Pressure Unit are presented in Table 1-1.



* Extended shaft for explosion-proof instruments and electronic transmitters

Figure 1-3. Differential Pressure Unit — Cut Away View

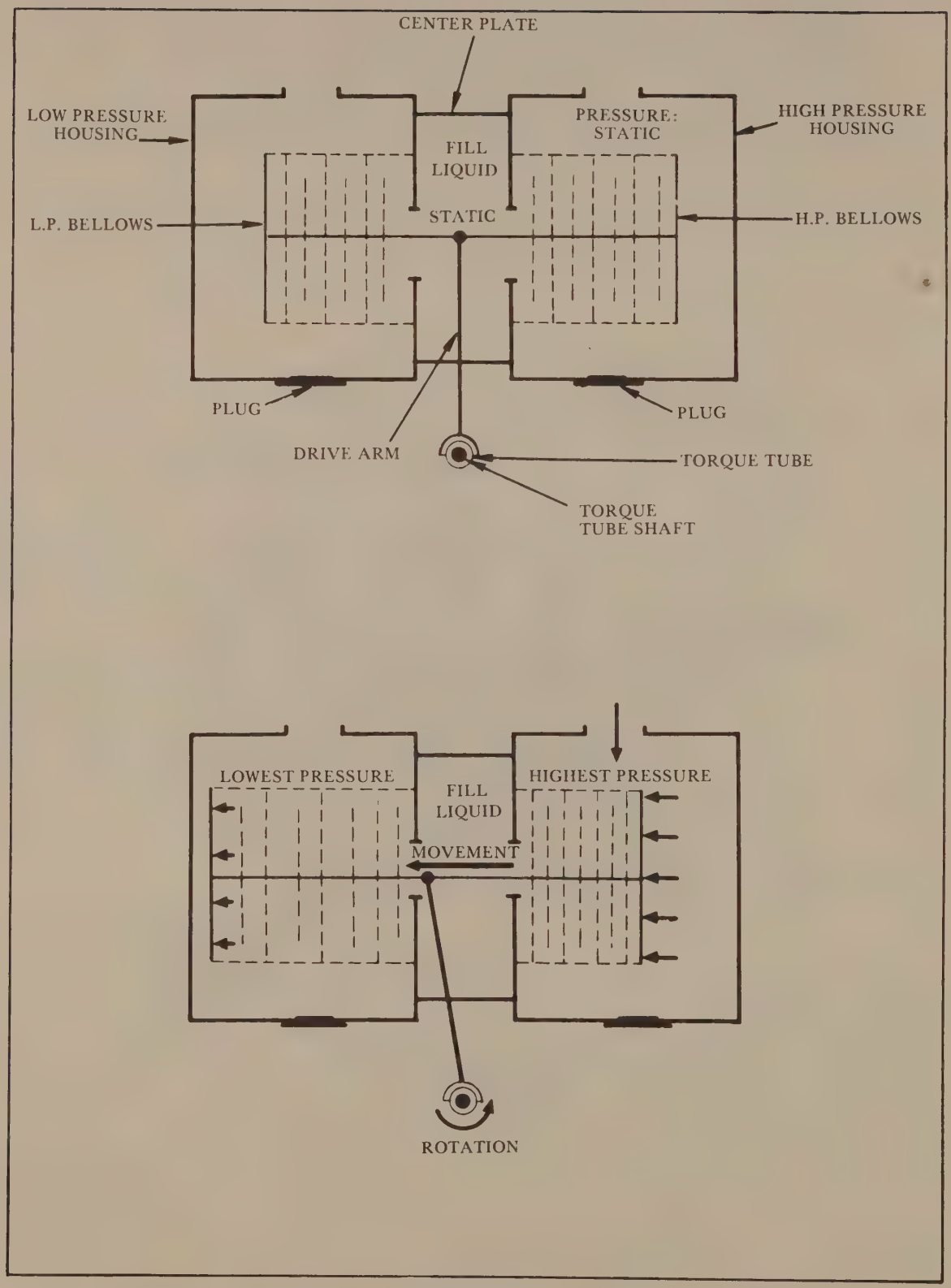


Figure 1-4. Mechanical Operation

SECTION 2

THEORY OF OPERATION

2-1. BASIC COMPONENTS (Figure 1-3)

A. Pressure Housings

The two pressure housings of the Model 224 DPU are available in the various safe working pressure ratings defined in Table 1-1 and in the outline dimension drawings (see Section 7).

Each pressure housing has two tapped connection ports: one port is located in the top of the housing; the other port is located in the bottom of the housing.

The pressure housings may be rotated 180 degrees to facilitate connection at the top of the housing for draining when used in gas service, or at the bottom to provide venting when used in liquid service.

The housings enclose the bellows on each side of the center plate.

B. Bellows

The bellows of the Model 224 DPU are available in the various materials and sizes defined in Table 1-1 to accommodate the various safe working pressure ratings.

The DPU has two bellows. One end of each bellows is sealed. The open end of each bellows is attached and sealed to a side of the center plate (one bellows on each side).

The bellows and center plate are filled with fill liquid via the drive arm hole plug. An opening through the center plate provides a passageway for the transfer of fill liquid between the two bellows. This opening also allows the bellows to be connected internally by a valve stem.

C. Range Springs

The range of the dual-bellows type DPU is determined by the force required to move the bellows through their normal range of travel.

The range springs, which are available in various ranges (Table 1-1), act with the bellows and torque tube to balance the differential pressure applied to the unit. The number of springs used and their spring rate depends on the individual differential pressure range requirement.

D. Torque Tube Assembly

The torque tube assembly consists of a torque tube, a torque tube shaft, and the supporting members. The outboard end of the torque tube shaft is attached to the center plate. The torque tube shaft, located in the center of the torque tube, is welded to the inboard end of the tube.

2-2. BASIC OPERATION (Figure 1-4)

The Model 224 Differential Pressure Unit (DPU) accurately measures the differential pressure in a process system relative to process functions and produces a mechanical output that actuates process monitoring instruments and process control devices.

The high-pressure (HP) housing is connected by pipe or tubing to the high-pressure side of the primary device. The low-pressure (LP) housing is connected to the low-pressure side of the primary device.

Any pressure change within the housing subjects the bellows to increasing pressure to contract laterally, forcing the fill liquid through the center plate into the bellows being subjected to the least amount of pressure and cause the latter to expand laterally. The amount of bellows movement is proportional to the difference in the pressure applied across the bellows unit assembly. The bellows moves in the direction of least pressure.

As the bellows move laterally, the connecting drive arm follows the motion of the bellows. The drive arm movement is transmitted through the follower arm to the torque tube.

Since the outer end of the torque tube is attached to the center plate, it must twist when subjected to torque. The twisting of the torque tube causes the torque tube shaft to rotate. The torque tube shaft, which is freely supported within the torque tube at its outer end but attached to the torque tube and drive arm at the inner end, rotates through the same angle as the drive arm.

The rotation of the torque tube shaft provides the mechanical motion required to actuate process instruments such as recorders, indicators, transmitters, controllers, and switches.

If the bellows are subjected to a pressure greater than the range of the Differential Pressure Unit, they move their normal travel range and a small amount of overtravel until the overrange valve seals against the valve seat. As the valve closes, the fill liquid is trapped in the bellows. Since the fill liquid is essentially non-compressible, the bellows are fully supported and will not rupture regardless of the overpressure (up to the full rated pressure of the instrument) applied to them. Also, since opposed valves are used, full protection against overrange is provided in either direction.

An additional convolution in the high-pressure side of the bellows provides for expansion or contraction of the fill liquid relative to ambient temperature changes. This extra convolution acts as an accumulator permitting the fill liquid to change volume without materially affecting the pressure within the bellows or changing the physical relationship of the two bellows.

SECTION 3

INSTALLATION

3-1. UNPACKING

The Barton ITT Model 224 DPU was inspected during manufacture and prior to shipping. However, an inspection should be made at the time of unpacking to detect any damage that may have occured during shipment.

CAUTION

THE DPU WAS CHECKED FOR ACCURACY AT THE FACTORY. DO NOT CHANGE ANY OF THE SETTINGS DURING EXAMINATION AS THIS WILL AFFECT ACCURACY.

For application in critical media, requiring special cleaning processes and precautions, a polyethylene bag is used to protect the instrument from contamination. This protective bag should be removed only under conditions of controlled extreme cleanliness.

The following items are included in each container:

- Model 224 Differential Pressure Unit
- Installation and Operation Manual
- Accessories per purchase order.

3-2. MOUNTING

A. Flush or Panel Mounting

Attach the case of the instrument (recorder, indicator, etc.) to the panel. Refer to the Installation and Operation Manual for the specific instrument for mounting details.

B. Pipe Mounting

Refer to the Outline Dimension Drawings in Section 7 for the pipe mounting diagram. The DPU must be mounted approximately level to operate properly.

3-3. PIPING — STANDARD PRACTICES

Observe the following practices on all flow and liquid level DPU piping applications:

1. Shorten the distance between the primary device and the DPU as much as possible. Distances exceeding 100 feet are not recommended. For distances up to 50 feet, use ¼-inch pipe or tubing. For runs of 50 to 100 feet, use ½-inch pipe or tubing. The recommended limitation does not apply if an air purge or blow-back system is used.

2. Slope all piping at least one inch per linear foot to avoid liquid or gas entrapment.

3. Provide two feet of uninsulated piping between the DPU and the primary device for each 100 degrees in excess of 200 degrees F, if process media exceeding 200°F must be measured.

4. Make certain that the temperature of the DPU never exceeds 200°F. When steam tracing is necessary, the steam pressure should not exceed five pounds per square inch and insulation should not be used. If pressure must exceed five pounds per square inch, limit the length of tubing around the DPU to two turns and do not insulate.

5. Install a suitable pulsation dampening device upstream of the DPU. Where severe pulsation is present, the accuracy of the flow measurement will be affected.

6. Mount the DPU on a solid support to minimize vibration. Make all piping joints leak tight, using suitable compound; leaks in piping can cause measurement errors.

7. Rotate the housing as necessary to place the connection in the proper position. The DPU has connections in the pressure housings to accomodate various pipe sizes (see outline dimension drawings, Section 7).

8. Install a valve manifold connecting the DPU and the source of differential pressure to facilitate operation and checking of the DPU.

9. Locate all shut-off valves and bypass valves to be readily accessible from the front of the instrument. Locate block valves at the source of differential pressure.

3-4. PIPING

Diagrams and startup instructions for typical and special flow applications are presented in Figures 3-1 thru 3-14, at the end of this section. Use the diagram most applicable to the specific requirement as a guide.

A. Flow Applications (Figures 3-1 thru 3-7)

Be sure to connect the DPU HP housing to the upstream tap of the primary device.

WARNING

DIRECT ALL PIPING VENTS AWAY FROM THE OPERATOR.

CAUTION

TO PREVENT OVERHEATING THE DPU DURING BLOWDOWN, THE OPERATOR SHOULD MONITOR THE TEMPERATURE BY PLACING HIS HAND ON THE PIPE BETWEEN THE DPU AND THE MANIFOLD PIPE IN WHICH THE VENT VALVES ARE LOCATED.

B. Liquid Level Applications (Figures 3-8 thru 3-13)

The process media may be used as a reference leg seal fluid when it is of a type that will condense in the reference leg under all conditions.

If the process or process media characteristics are such that the above conditions cannot be met, a special reference leg seal fluid will be required. The special seal fluid must not be volatile and must not be miscible with the process media. Also, the difference in the densities of the special seal fluid and the process media will require compensation in calculating the differential pressure range of the DPU.

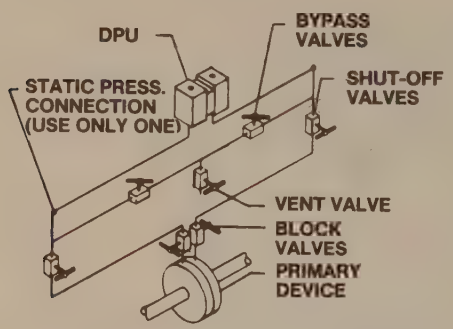
If there are any questions regarding this procedure, contact the factory.

WARNING

NO ORGANIC COMPOUNDS, OIL, GREASE, DIRT, OR SCALE OF ANY KIND CAN BE TOLERATED IN AN OXYGEN INSTALLATION.

C. Liquid Specific Gravity Applications (Figure 3-14)

This method of piping is used for determining specific gravity changes in a process media using differential pressure instruments.

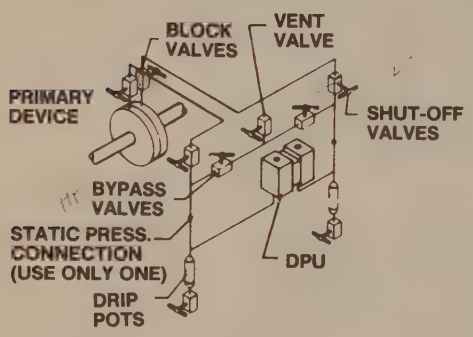


STARTUP

1. Open bypass valve(s). Close vent valve. Open both shut-off valves and one block valve to pressurize DPU, then close block valve.
2. Close one bypass valve and check system for leaks. If output travels upscale, check for low-pressure piping leak. If output travels downscale, check for high-pressure piping leak.
3. Repair piping if necessary and repeat steps 1 and 2 until output remains stationary at zero.
4. Close both shut-off valves. Open bypass valve(s). Open both block valves. Slowly open both shut-off valves.
5. Close bypass valves. If two bypass valves are used, open vent valve.

Recommended for use whenever possible, as the DPU is self-draining. NOT recommended when hydrates are present.

Figure 3-1. Gas Flow, DPU Above Run.

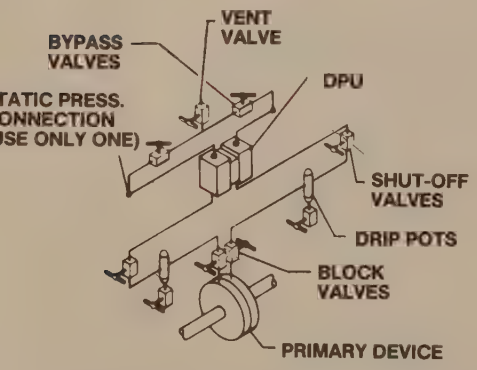


STARTUP

1. Open bypass valve(s). Close vent valve. Open shut-off and block valves to pressurize DPU. Close block valve.
2. Close one bypass valve and check for leaks. If output travels upscale, check for low-pressure piping leak. If output travels downscale, check for high-pressure piping leak.
3. Repair piping as necessary and repeat steps 1 and 2 until output remains stationary at zero.
4. Close both shut-off valves. Open bypass valve(s). Open both block valves. Slowly open both shut-off valves.
5. Close bypass valves. If two bypass valves are used, open vent valve.
6. If drip pots are used, open drip valves and blow out accumulated liquid.

Used ONLY when necessary to mount DPU below run. Drip pots required when wet gas is present.

Figure 3-2. Gas Flow, DPU Below Run.

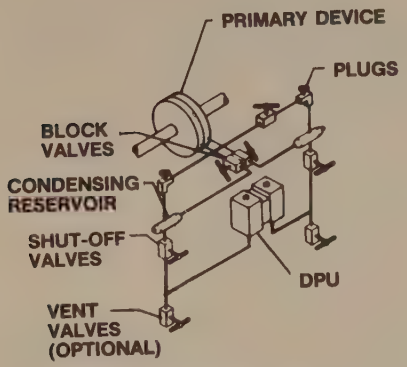


STARTUP

1. Open bypass valve(s). Close vent valve. Open both shut-off valves and one block valve to pressurize DPU. Close block valve.
2. Close one bypass valve and check for leaks. If output travels upscale, check low-pressure piping for leak. If output travels downscale, check for high-pressure piping leak.
3. Repair piping as necessary and repeat steps 1 and 2 until output remains stationary at zero.
4. Close both shut-off valves. Open bypass valve(s). Open both block valves. Slowly open both shut-off valves.
5. Close bypass valves. If two bypass valves are used, open vent valve.
6. Drain drip pots of hydrates at regular intervals.

Used if hydrates or heavy solids are present. Piping and shut-off not less than ½" diameter. Bypass manifold above, to isolate meter from connecting piping. Drip pots prevent plugging.

Figure 3-3. Gas Flow, Hydrates Present.



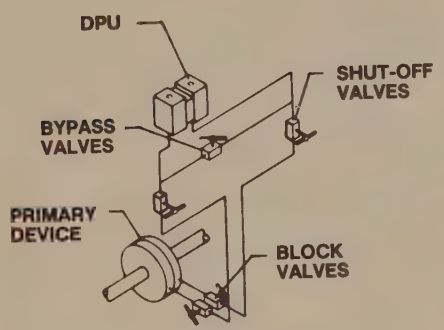
STARTUP

1. Close vent valves, if used: Open bypass and shut-off valves.
2. Remove condensing reservoir side and fill plugs.
3. Pour water into both reservoirs until piping and DPU housing are filled. Piping and housing chambers shall be free of bubbles. Pointer will rest at zero (or output will be 4 mA or 10 mA, as applicable) when instrument and piping are completely filled.
4. Install side and fill plugs in reservoirs.
5. Close shut-off valves. Open block valves.
6. Simultaneously, slowly open both shut-off valves. Check for leaks.
7. Close bypass valve.

CAUTION
USE PLUGS; NEVER VALVES ON DPU.

Condensing reservoirs and piping to orifice taps must be level.
Reservoirs and steam line at same level. 2″ pipe crosses may be used as seal pots.

Figure 3-4. Steam Flow, DPU Below Run.

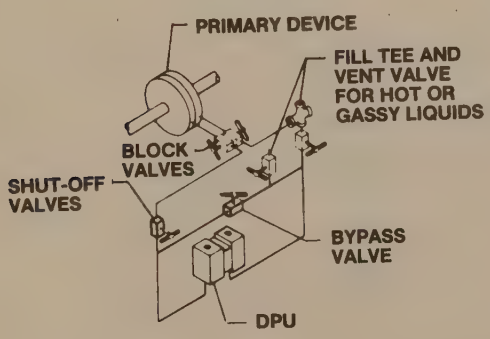


STARTUP

1. Close both shut-off valves. Open both block valves.
2. Open bypass valve. Crack vent valves or loosen plugs from top ports of DPU body housings.
3. Crack and close shut-off valves alternately until liquid, free of bubbles, spills out of both upper DPU body ports.
4. Close vent valves or tighten plugs. Close block valves and open shut-off valves.
5. Indicator will be at zero (or output will be 4 mA or 10 mA, as applicable). If not, and no leaks are detected, the housing and/or piping are not completely filled with liquid. Repeat steps 1 through 4 until output remains stationary at lowest value.
6. Slowly open both block valves. Close bypass valve.

Recommended if sediments may be present. Periodic inspections of piping are necessary.
Not recommended for hot or gassy liquids.

Figure 3-5. Liquid Flow, DPU Above Run.

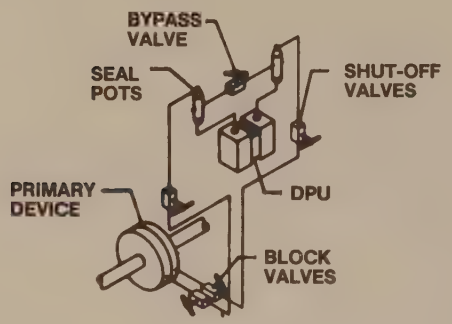


STARTUP

1. Close both shut-off valves. Open both block valves.
2. Open bypass valve. Crack vent valves or loosen plugs from top ports of DPU pressure housings.
3. Crack and close shut-off valves alternately until liquid, free of bubbles, spills out of both upper DPU body ports.
4. Close vent valves or tighten plugs. Close block valves and open shut-off valves.
5. Indicator will be at zero (or output will be 4 mA or 10 mA, as applicable). If not, and no leaks are detected, the housing and/or piping are not completely filled with liquid. Repeat steps 1 through 4 until output remains stationary at lowest value.
6. Slowly open both block valves. Close bypass valve.
7. For service with hot or gassy liquids, fill both sides of the manifold through the fill tee, with the liquid to be measured cooled to 200°F or less, expell gas bubbles from DPU and piping.
8. Open vent valve in bypass valve. Tighten fill plug when bubble-free liquid flows.

Recommended for hot or gassy liquids. Periodic inspections of piping are recommended.

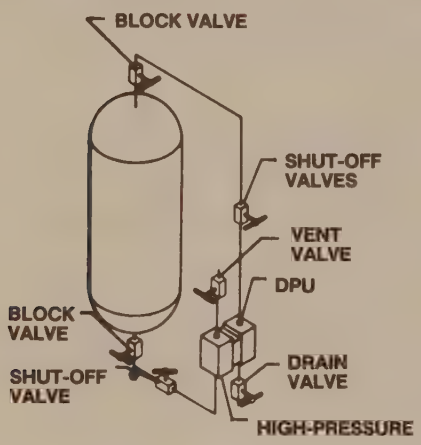
Figure 3-6. Liquid Flow, DPU Below Run.



STARTUP

1. Close shut-off valves. Open block valves. Open bypass valve. Close DPU drain plugs.
2. Remove fill and side plugs from seal pots.
3. Fill seal pots, piping and DPU housing with immiscible seal fluid by pouring into upper fill ports. DPU housing tubing, and seal pots must be filled to seal pot side ports with bubble-free liquid. Pointer will indicate zero (or 4 mA or 10 mA, as applicable) when high- and low-pressure chambers are filled with liquid.
4. Install side plugs.
5. Slowly open each shut-off valve alternately, until bubble-free line liquid spills from both upper fill plugs.
6. Replace fill plugs.
7. Open and close block valves. Check for piping leaks. Repair as needed.
8. Close shut-off valves and open block valves.
9. Slowly open both shut-off valves. Close bypass valve.

Figure 3-7. Corrosive Liquid Flow.



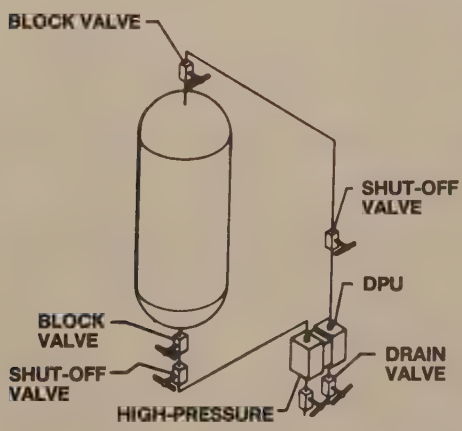
STARTUP

1. Close both shut-off valves. Open lower block valve and crack vent valve.
2. Slowly open lower shut-off valve. When bubble-free liquid spills from vent, close vent valve.
3. Open upper block valve. Slowly open shut-off valve.
4. Crack drain valve to remove any condensation. Close drain valve.

CAUTION
DO NOT SHARE FILLING OR VAPOR
RETURN LINES WITH DPU PIPING.

High-pressure side of DPU connected to bottom outlet of tank.
Low-pressure side connected to top or gas outlet of tank.

Figure 3-8. Cool Non-Condensing Liquid, DPU Level With Tank Bottom.



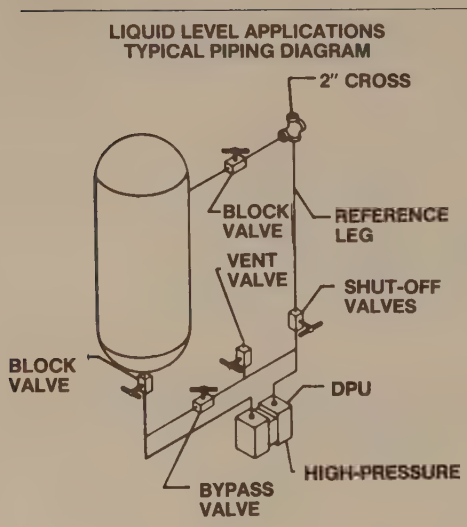
STARTUP

1. Close both shut-off valves. Open lower block valve and crack vent valve.
2. Slowly open lower shut-off valve. When bubble-free liquid spills from vent, close vent valve.
3. Open upper block valve. Slowly open shut-off valve.
4. Crack drain valve to remove any condensation. Close drain valve.

CAUTION
DO NOT SHARE FILLING OR VAPOR
RETURN LINES WITH DPU PIPING.

Either piping layout (Figures 1-10 and 1-11) is suitable for water, oil, or other media which will not condense in low-pressure piping.

Figure 3-9. Cool Non-Condensing Liquid, DPU Below Tank.



CAUTION

DO NOT SHARE FILLING AND VAPOR RETURN LINES WITH DPU PIPING LINES.

STARTUP

Cool Liquids: Use of reference leg cancels out the "dead leg" (piping from tank bottom to center line of meter body). Seal fluid in reference leg must not volatize. Process media can be used as a reference leg seal fluid if it is such that it will condense in reference leg under all conditions. Otherwise, special, non-miscible seal fluid must be used. Difference in densities between process media and seal fluid must be considered when computing differential pressure range of DPU.

1. Partially fill reference leg by opening bottom block valve, both shut-off valves, and bypass valve.
2. Crack drain plugs on DPU housing and vent valve. Close when clear, bubble-free liquid flows.

LIQUID LEVEL APPLICATIONS

DPU Below Tank With Reference Leg. (Cont)

3. Close bypass and shut-off valve on reference leg.
4. Remove plug from top port in 2-inch pipe cross connection, and fill the reference leg manually. Open the top shut-off valve and crack vent valve until bubbles are expelled. Leave reference leg full.
5. Replace plug in pipe cross and close vent valve.
6. Slowly open upper block valve.

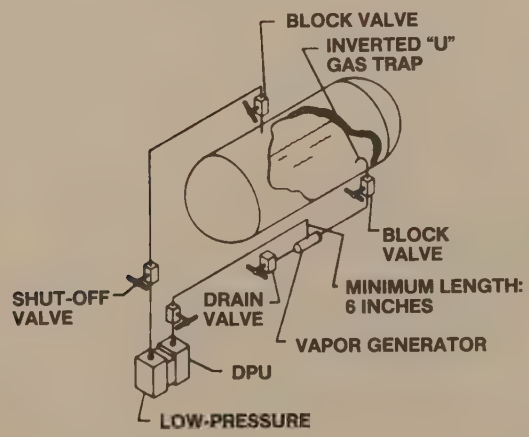
STARTUP

Hot Liquids: (Volatile):

1. Open both shut-off valves, bypass valve, and vent valve.
2. Remove plug from top port in 2-inch pipe cross. Fill both high and low DPU housings with liquid until it runs out of vent valve. Use liquid to be measured, cooled to below 200°F of other suitable seal liquid. Expel bubbles in DPU housing. Proceed to step 3 above.

If bypass valve is opened at any time, the reference leg must be filled again. If no bypass is installed, disregard steps 1, 2, and 3. Open lower block valve in step 5 and shut-off valve in step 6.

Figure 3-10. DPU Below Tank With Reference Leg.



STARTUP

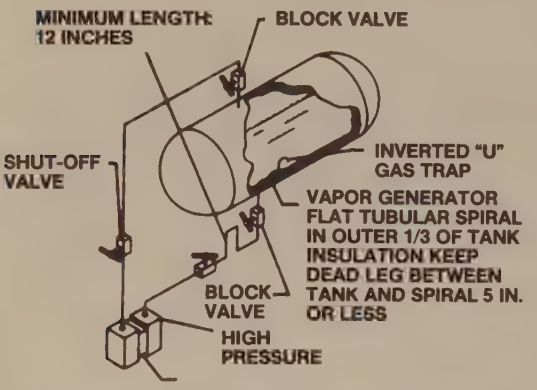
1. Close shut-off valves.
2. Open drain valve and DPU housing drain plugs to remove all liquid from system. Close drains.
3. Open bottom block valve slowly to allow liquid to enter gas generator. Vent valve must be closed.
4. Open top block valve.
5. Open shut-off valves.

CAUTION

DO NOT INSULATE PIPING BELOW LOWER BLOCK VALVE. DO NOT SHARE FILLING AND VAPOR RETURN LINES WITH DPU PIPING LINES.

Instrument may be located above or below vessel. Recommended vapor generator is a twelve-inch length of 1- to 1½-inch diameter pipe. Avoid traps or pockets between vapor generator and tank. Install inverted "U" shaped gas trap inside the vessel.

Figure 3-11. Liquid CO_2


MINIMUM LENGTH 12 INCHES
BLOCK VALVE
SHUT-OFF VALVE
INVERTED "U" GAS TRAP
VAPOR GENERATOR FLAT TUBULAR SPIRAL IN OUTER 1/3 OF TANK INSULATION KEEP DEAD LEG BETWEEN TANK AND SPIRAL 5 IN. OR LESS
BLOCK VALVE
HIGH PRESSURE

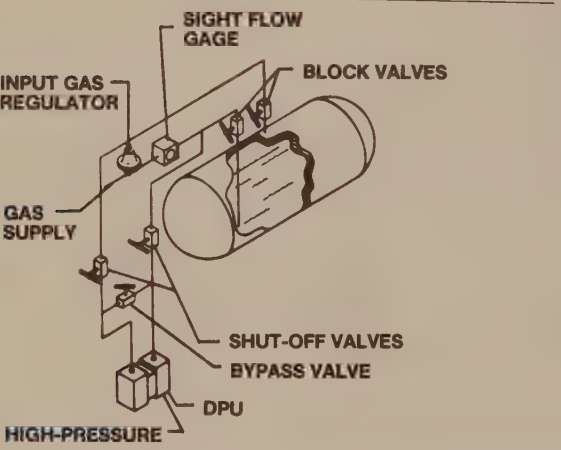
STARTUP

1. Close shut-off valves.
2. Open drain valve and DPU housing drain plugs to remove all liquid from system. Close drains.
3. Open bottom block valve slowly to allow liquid to enter gas generator. Vent valve must be closed.
4. Open top block valve.
5. Open shut-off valves.

CAUTION
DO NOT SHARE FILLING AND VAPOR RETURN LINES WITH DPU PIPING LINES.

Instrument may be located above or below vessel. Recommended vapor generator is a spiral of ⅜-inch tubing. Install inverted "U" shaped gas trap inside the vessel. Meters for oxygen service are specially cleaned and packaged in polyethylene bags, and must be kept extremely clean.

Figure 3-12. Cryogenic Liquids.



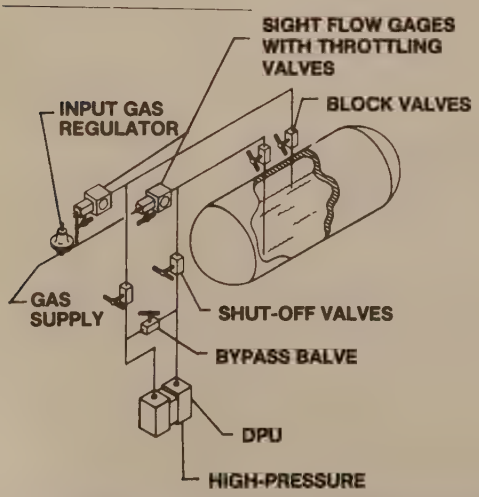
STARTUP

1. Set bubbler input gas regulator pressure slightly higher than process vessel pressure.
2. Open block valves and shut-off valves. Close bypass valve.
3. Check sight-flow for gas flow into bubbler tube.
4. Adjust bubbler system to minimum flow by setting regulator in Figure 3-2 Installations and Sight Flow Throttling Valves in Figure 3-3 Installations.

CAUTION
DO NOT SHARE FILLING AND VAPOR RETURN LINES WITH DPU PIPING LINES.

Recommended when piping connections must be made at the top of the tank or whenever solids or sludge are present.

Figure 3-13. Bubbler System.



STARTUP

1. Set bubbler input gas regulator pressure slightly higher than process vessel pressure.
2. Open block valves and shut-off valves. Close bypass valve.
3. Check sight-flow for gas flow into bubbler tube.
4. Adjust bubbler system to minimum flow by setting regulator in Figure 3-2 Installations and Sight Flow Throttling Valves in Figure 3-3 Installations.

CAUTION
DO NOT SHARE FILLING AND VAPOR RETURN LINES WITH DPU PIPING LINES.

This method is for determining specific gravity changes in a process media using a differential pressure instrument.

Figure 3-14. Liquid Specific Gravity.

SECTION 4

OPERATION AND SERVICE

4-1. STARTUP PROCEDURE

The startup procedures are presented with the piping diagrams in Section 3, Figures 3-1 thru 3-14.

4-2. GENERAL PRACTICE CONSIDERATIONS

Observe the following practices when starting up an instrument:

1. Always start with block valves closed.
2. Perform a zero check on the instrument, as follows:
   a. Open bypass valve(s), then open one shut-off valve. This procedure equalizes the pressure between both sides of the instrument. The instrument should indicate zero.
   b. If the instrument does not indicate zero, check for gas or liquid entrapment in the lines or in the DPU (depending on the orientation of the piping layout and service).
   c. If necessary adjust the pen or pointer by turning the zero adjust on the instrument.

NOTE

For gas service, it is recommended that zero check be performed with both block valves closed. If the gas flow is pulsating, there may be a standing wave effect in the process line which can displace the indicator and appear as a zero error.

3. Check the manifold and piping for leaks, as follows:
   a. Open bypass valve(s), then open one shut-off valve to pressurize the instrument.
   b. Close the shut-off valve and the bypass valve.
   c. Any leakage will be indicated by pen or pointer movement, up or down scale.

CAUTION

BE CAREFUL NOT TO SUBJECT DPU TO UNNECESSARY SHOCK OR OVERRANGE PRESSURE DURING STARTUP OPERATIONS.

SECTION 5

CALIBRATION AND SERVICING

5-1. CALIBRATION

The test equipment required to calibrate the Model 224 Differential Pressure Unit when attached to a recorder or indicator is presented in Figure 5-1.

All Barton instruments using a Model 224 DPU as the actuator are calibrated at the factory.

All DPU's sold as replacement units or as actuators for other applications are checked for accuracy prior to shipment.

Normally, the DPU is calibrated after installation on a specific instrument. Refer to the instrument Technical Manual for the calibration procedure.

5-2. TROUBLESHOOTING

The troubleshooting procedure is presented in Table 5-1. Also, refer to the instrument Technical Manual for further troubleshooting suggestions. Usually, problems will be found outside of the DPU or the attached instrument.

5-3. SERVICING TOOLS

Description	Purpose
Screwdriver	Bracket screws
Torque Wrench (50 ft/lb)	Pressure housing bolts (see Table 5-2)

5-4. CLEANING AND INSPECTION

Instruments used in services where solids or semi-solids may accumulate inside the pressure housings require periodic inspection and cleaning, as follows:

1. Remove the DPU from service and remove the pressure housings.
2. Carefully remove the pressure housings from the bellows unit assembly.

CAUTION

IF THE ACCUMULATION OF MATERIAL INSIDE THE HOUSING IS EXTENSIVE, RAPID REMOVAL OF THE HOUSING MAY DAMAGE THE BELLOWS CONVOLUTIONS.

3. Remove the accumulation from between the bellows convolutions and from the inside of the housings. Use a solvent if possible. Do **NOT** use a sharp instrument to clean between the convolutions.

4. Check for broken range springs.

5. Replace the housings. New O-rings are recommended.

6. Set the pressure housing bolts to the torque values listed in Table 5-2.

5-5. RANGE CHANGE

To change the range of the Model 224 DPU requires replacing the bellows unit assembly (paragraph 5-6) with a unit of the desired range.

5-6. BELLOWS UNIT ASSEMBLY (BUA) REPLACEMENT (Figure 1-3)

CAUTION

DO NOT LOOSEN THE DRIVE ARM HOLD PLUG LOCATED IN THE TOP OF THE BUA CENTER PLATE, WHEN REMOVING THE MOUNTING BRACKET. IF THE PLUG IS LOOSENED, THE FILL FLUID IN THE BELLOWS WILL BE LOST.

1. Disconnect the DPU piping and remove the instrument from service. Remove the mounting bracket from the DPU.

2. Loosen the instrument drive arm and separate it from the torque tube shaft. Do not disconnect the instrument linkage.

NOTE

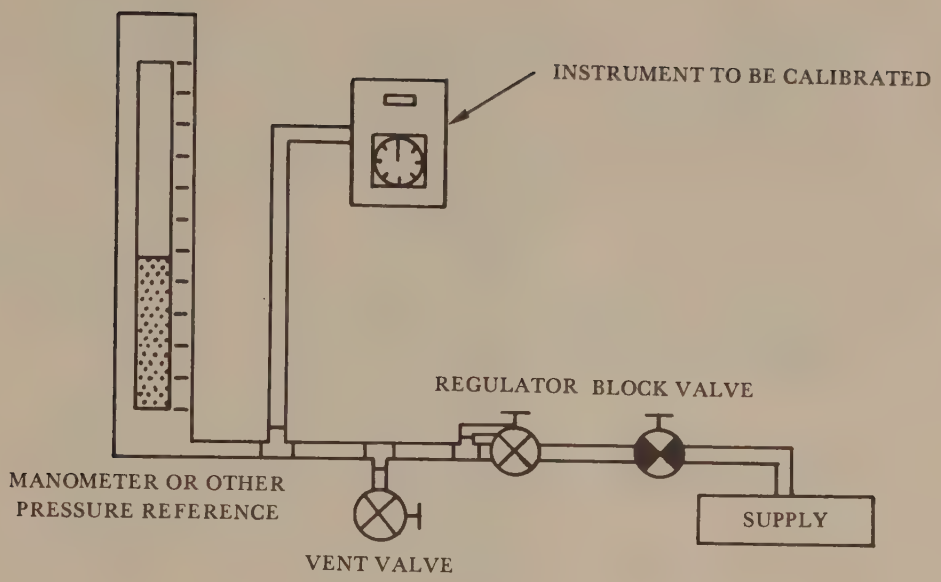
See the Technical Manual for the particular instrument for components that must be removed to gain access to the DPU mounting screws. Support the DPU and remove the mounting screws.

3. Remove the pressure housing bolts and remove the pressure housings.

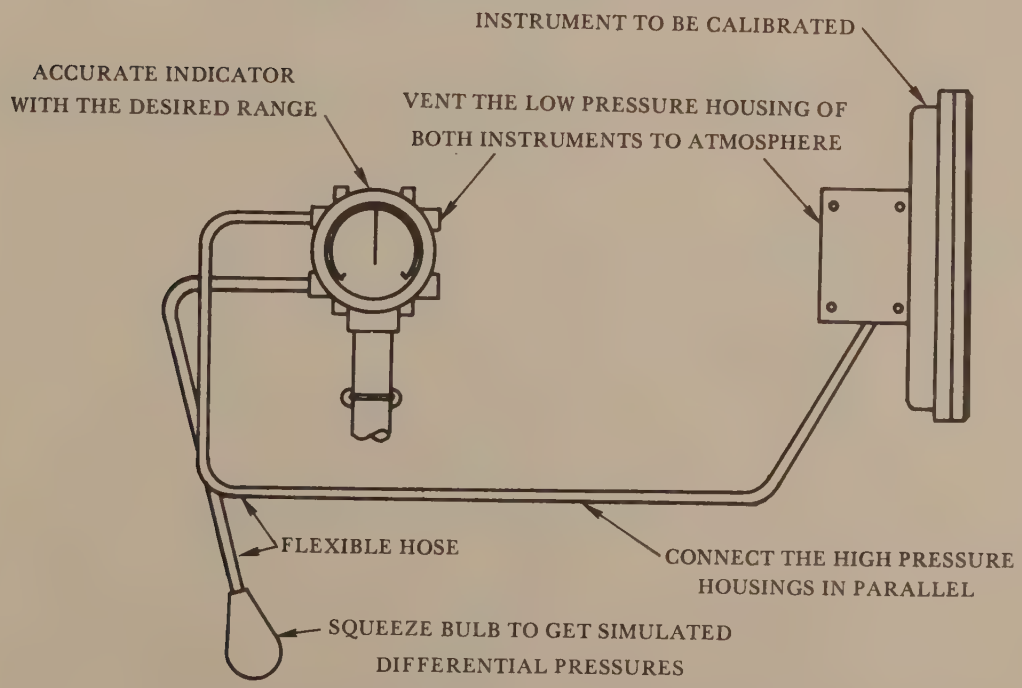
4. Place the pressure housings onto the new BUA and attach with the housing bolts (see Table 5-2 for torque requirements).

   It is recommended that new O-rings be used when replacing the pressure housings.

5. Reattach the DPU to the instrument and install the instrument into service in reverse order of removal.



TYPICAL PRESSURE CALIBRATION SETUP



PORTABLE PRESSURE CALIBRATION SETUP

Figure 5-1. Instrument Calibration Setup

Table 5-1. Troubleshooting Chart

Problem	Probable Location	Possible Cause	Corrective Action
Low or No Indication	Primary Element or Differential Pressure Source	Orifice installed backwards, or oversized.	Replace orifice.
		Flow blocked upstream from run.	Clean out run or open valve.
		Loss of liquid in reference leg (liquid level).	Refill reference leg.
		Density changes in process media or reference leg.	Refill reference leg with same density liquid as process media.
	Piping from Primary Element to DPU	Pressure tap holes plugged and/or piping plugged.	Clean out piping.
		Bypass valve open or leaking.	Close bypass valve(s).
		Liquids or gasses trapped in piping.	Vent piping.
		Block or shut-off valves closed.	Open block or shut-off valves.
		Piping leaks, high-pressure side.	Repair leaks.
	Bellows Unit	Housings filled up with solids restricting bellows movement.	Clean out housing.
		Gas trapped in housing in liquid service or liquid trapped in housing in gas service.	Vent housing.
		High-pressure housing gasket leaks.	Replace gasket.
		DPU tampered with.	Return BUA for repair.
	Mechanism	Loose links or movements.	Tighten or replace.
		Out of calibration.	Recalibrate.
		Corrosion or dirt in mechanism.	Clean or replace.
		Pointer loose.	Tighten.
Indicates High	Primary	Orifice partially restricted, or too small.	Clean out or replace.
	Piping from Primary Element to DPU	Leak in low-pressure side piping.	Repair.
	Bellows Unit	Gas trapped in low-pressure housing in liquid service or liquid trapped in high-pressure housing in gas service.	Vent housing.
		Low-pressure housing gasket leaks.	Replace gasket.
		Range spring broken, or DPU tampered with.	Return BUA for repair.
	Mechanism	Loose links or movements.	Repair or replace.
		Out of calibration.	Recalibrate.

Table 5-1. Troubleshooting Chart (Cont)

Problem	Probable Location	Possible Cause	Corrective Action
Erratic Indication	Primary	Flow pulsating.	Install dampening device upstream of DPU run.
	Piping from Primary Element to DPU	Liquid trapped in gas piping or gas bubble in liquid piping. Vapor generator incorrectly installed. Reference leg gassy or liquid vaporizing.	Remove (see startup instructions). Repipe. See piping instructions.
	Bellows Unit	Obstructed bellows travel. Gas trapped in DPU high-pressure or low-pressure housing.	Clean bellows. Remove (see startup instructions).
	Mechanism	Linkage dragging or dirty. Pointer dragging on scale plate.	Adjust or clean. Adjust.

Table 5-2. Torque Tube

Housing		Housing Screws		Lube (Note 1)	Torque Lb/Ft (Note 2)	Rotation Degrees (Note 3)
SWP	Material	Material	Size			
400	Aluminum	Steel	¼ — 28 x 2″	NO	8-10	135
		Cres	¼ — 28 x 2″	NO		135
500	Brass	Steel	¼ — 28 x 2″	NO	8-10	135
		Monel	¼ — 28 x 2″	YES	8-10	180
1,000	Copper Alloys	Steel	¼ — 28 x 2.5	NO	9-11	180
		Monel	¼ — 28 x 2.5	YES	9-11	180
1,500	Steel	Steel	¼ — 28 x 2.5	NO	12-14	180
		Monel	¼ — 28 x 2.5	YES	12-14	180
	Cres	Steel	¼ — 28 x 2.5	NO	12-14	180
		Cres	¼ — 28 x 2.5	YES	12-14	180
3,000	Steel	Steel	⅜ — 24 x 2.5	NO	30	90
	Cres	Cres	⅜ — 24 x 2.5	YES	35	90
			⅜ — 24 x 3.0	YES	35	90
6,000	Steel	Steel	⅜ — 24 x 2.5	NO	35	135
	Cres	Cres	⅜ — 24 x 2.5	YES	40	135
10,000	Steel	Steel	⅜ — 24 x 2.5	YES	40	180
	Cres	Cres	⅜ — 24 x 2.5	YES	45	180

NOTE: (1) Lubricants: Molykote G paste, Teflon-base pipe dope, graphite-base grease, or similar lubricants. Lube first thread only.

(2) Torque on screws is accomplished in 3 or 4 steps. Tighten UNIFORMLY.

(3) Rotation of screw head is measured after screw is "snug", with approximately 2 lb/ft torque. **DO NOT EXCEED THIS ROTATION.** To tighten screws without torque wrench, use these values:

¼ turn = 90° ½ turn = 180°

SECTION 6

PARTS LIST

6-1. PARTS LIST

The parts list for the Model 224 Differential Pressure Unit is presented in Table 6-1.

6-2. COMPONENT IDENTIFICATION

The components listed in the parts list are identified in Figure 6-1.

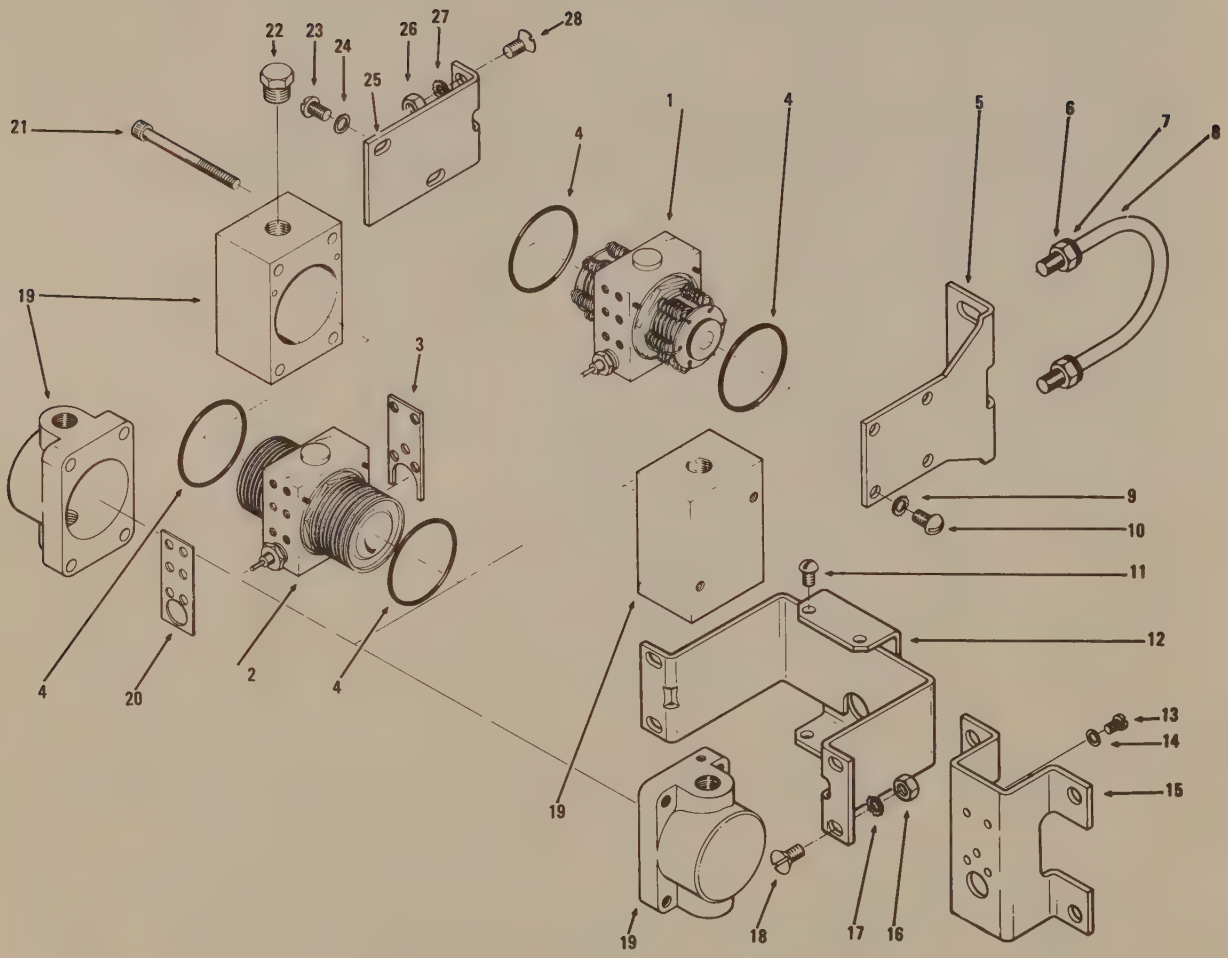


Figure 6-1. Model 224 Differential Pressure Unit Parts Identification

Table 6-1. Parts List, Model 224 Differential Pressure Unit

Item	Description	Part No.	Per Unit
1	Bellows Unit Assembly, ¾"	—	
2	Bellows Unit Assembly, 1⅝"	—	
3	Spacer	0224.0302.C	1
*4	O-Ring, Flange Gasket		
	(for all BeCu units, except 10,000 psi)	0001.0028.R	2
	(for all S.S. units, except 10,000 psi), Viton	0001.0039.R	2
	(for all 10,000 psi units only), Buna-N	0001.0048.R	2
5	Bracket, Mounting, U-Bolt Type (for housings 1000 psi and over)	0273.0001.C	2
6	Nut, Steel, 5/16-18 CP	0500.0033.J	4
7	Washer, Split Lock, 5/16" Steel	0003.0006.K	4
8	U-Bolt, (Complete with nuts)	0440.0001.J	2
9	Washer, Split Lock, ¼" Steel	0003.0013.K	8
10	Screw, Steel CP, ¼-28 x ⅝"	0111.0033.J	8
11	Screw, Steel CP, 10-32 x ⅜"	0111.0057.J	4
12	Bracket, Flush Impact (for 500 psi Forged Brass units only)	0224.0235.B	1
13	Screw, Brass NP, 10-32 x ½"	0111.0012.J	4
14	Washer, Split Lock, #10	0003.0032.K	4
15	Bracket, Mounting, U-Bolt Type (for 400 and 500 psi housings)	0273.0003.C	1
16	Nut, Steel CP, ¼-28	0500.0011.J	4
17	Washer, Lock, Steel, ¼"	0003.0068.K	4
18	Screw, Steel CP, ¼-28 x ½"	0112.0018.J	4
19	Head		
	Aluminum		
	†400 psi, drilled	0224.0083.C	
	†400 psi, tapped	0224.0082.C	
	Brass		
	††500 psi, drilled	0224.0099.C	
	††500 psi, tapped	0224.0098.C	
	†1000 psi, drilled	0224.0092.C	
	†1000 psi, tapped	0224.0091.C	
	Steel		
	††1500 psi, drilled	0224.0014.C	
	††1500 psi, tapped	0224.0037.C	
	†††3000 psi, drilled	0224.0039.C	
	†††3000 psi, tapped	0224.0012.C	
	†††6000 psi, drilled	0224.0067.C	
	†††6000 psi, tapped	0224.0068.C	
	††††6000 psi, drilled	0224.0070.C	
	††††6000 psi, tapped	0224.0071.C	
	††††10,000 psi, drilled, H.P.	0224.0135.C	
	††††10,000 psi, tapped, H.P.	0224.0136.C	

Table 6-1. Parts List,
Model 224 Differential Pressure Unit (Cont)

Item	Description	Part No.	Per Unit
	Stainless Steel		
	††500 or 1500 psi, drilled	0224.0118.C	
	††500 or 1500 psi, tapped	0224.0117.C	
	†††3000 or 6000 psi, tapped	0224.0119.C	
	†††3000 or 6000 psi, drilled	0224.0120.C	
	††††6000 psi, tapped	0224.0123.C	
	††††6000 psi, drilled	0224.0124.C	
	Copper Nickel (70-30)		
	‡1000 psi, drilled, MIL-C-15726	0224.0265.C	
	‡1000 psi, tapped, MIL-C-15726	0224.0266.C	
20	Spacer	0273.0002.C	1
21	Screw, Housing		4
	400 and 500 psi DPU		
	Steel, CP, ¼-28 x 2″	0220.0035.J	
	Stainless Steel, ¼-28 x 2″	0220.1016.J***	
	1000 and 1500 psi DPU		
	Stainless Steel (S.S.), ¼-28 x 2½″	0220.1017.J***	
	Steel, CP ¼-28 x 2½″	0220.0029.J	
	3000, 6000, and 10,000 psi DPU		
	S.S., ⅜-24 x 2½″	0220.1014.J***	
	Steel, CP, ⅜-24 x 2½″	0220.0022.J	
22	Plug, Pipe		2
	400 psi DPU, ⅛″ NPT, Aluminum	0221.0097.C	
	500 psi DPU, ¼″ NPT, Brass	0221.0100.C	
	1000 psi DPU, ⅛″ NPT, Brass	0229.0058.C	
	1500, 3000, and 6000 psi, Steel DPU, ¼″ NPT, Steel CP	0199.0191.C	**
	1500 and 6000 psi, S.S. DPU, ¼″ NPT	0199.0214.C	**
	3000 and 6000 psi, Steel DPU, ½″ NPT, Steel CP	0199.0192.C	**
	6000 psi, S.S. DPU, ½″ NPT	0199.0215.C	**
23	Screw, ¼-28 x ⅝″, Steel CP	0111.0033.J	4
24	Washer, Split Lock, ¼″ Steel	0003,0013.K	4
25	Bracket Mounting (for 1000 psi and over housings)	0224.0055.C	2
26	Nut, ¼-28 Steel CP	0500.0011.J	4
27	Washer, Lock, ¼″ Steel	0003.0068.K	4
28	Screw, ¼-28 x ½″, Steel CP	0112.0018.J	4

NOTES:

As normally furnished, units having beryllium-copper bellows are fitted with Buna-N O-rings and units having stainless steel bellows, with Viton O-rings. In all cases, however, the O-ring compound must be selected for compatibility with the metered material. Consult the factory for other compounds.

Table 6-1. Parts List,
Model 224 Differential Pressure Unit (Cont)

* Indicates recommended spare parts.

** Pipe Plugs: 1500 psi units — two ¼″ required; 3000 and 6000 psi units — two ¼″ or two ½″, depending on which ports are to be plugged.

*** Stainless steel housing screws are recommended where the instrument is installed in a corrosive environment.

† Pressure parts are both ⅛″ NPT.
†† Pressure ports are both ¼″ NPT.
††† Pressure ports are ½″ NPT top, ¼″ NPT bottom.
†††† Pressure ports are both 9/16-18 UNF-2B.
‡ Pressure ports are MS16142-4.

When ordering parts, please specify serial number of instrument with which parts are to be used.

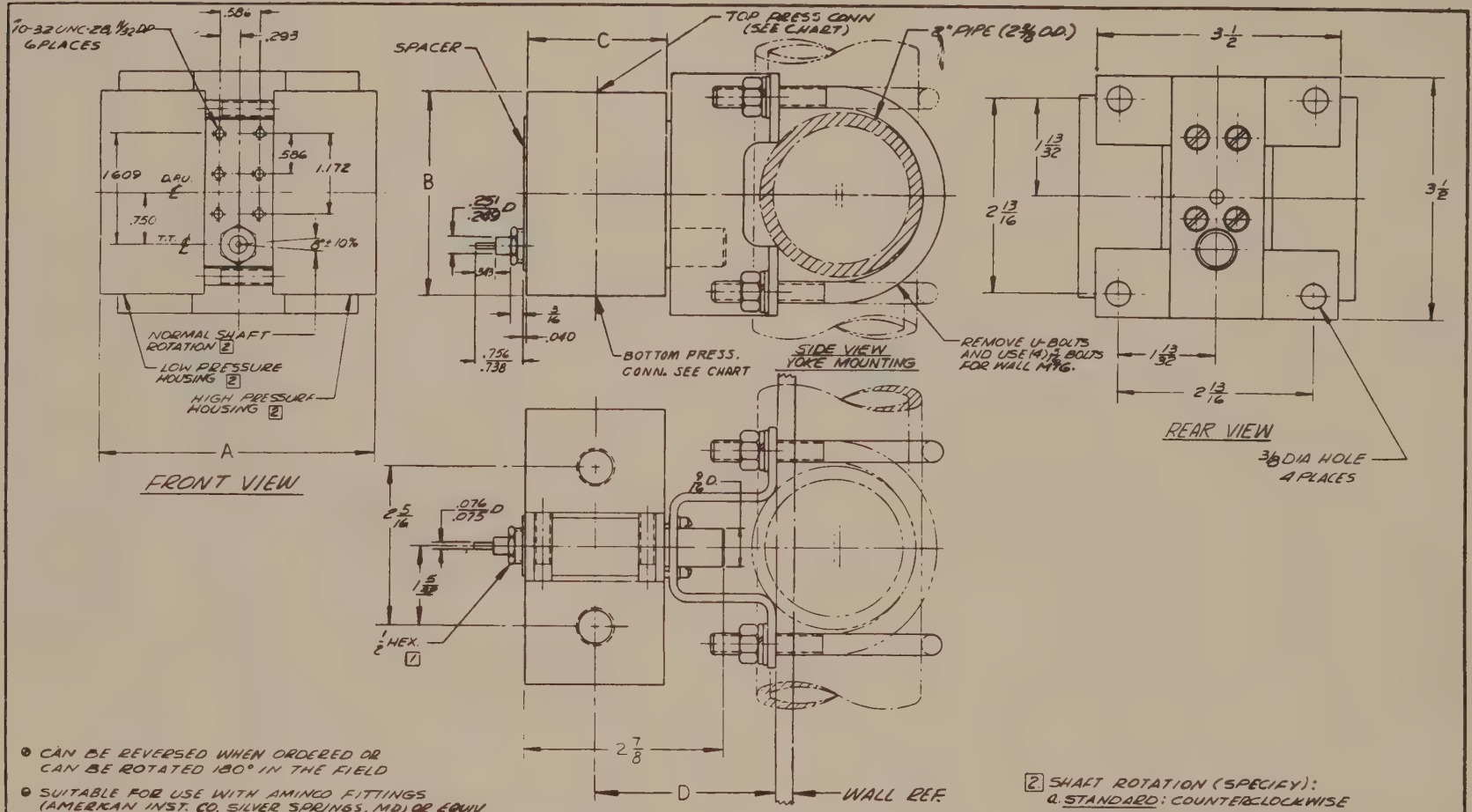
SECTION 7

DRAWINGS

7-1. OUTLINE DIMENSION DRAWINGS

The latest revision of the following outline dimension drawings are presented in this section:

0224.0901.3
0224.0903.3
0224.0904.3
0224.0912.3
0224.1047.3



● CAN BE REVERSED WHEN ORDERED OR CAN BE ROTATED 180° IN THE FIELD

● SUITABLE FOR USE WITH AMINCO FITTINGS (AMERICAN INST. CO. SILVER SPRINGS, MD) OR EQUIV.

PRESSURE RATING	HOUSING MATERIAL	TOP PRESSURE	BOTTOM CONNECTION	A	B	C	D
10,000 PSI	E 4140 ALLOY ST	¼ A.N.P.T. ●9/16-18 UNF	¼ A.N.P.T. ●9/16-18 UNF	4 3/8	3 1/4	2 1/4	2 3/4
6,000 PSI	316 ST. ST.	¼ A.N.P.T. ●9/16-18 UNF	¼ A.N.P.T. ●9/16-18 UNF				
	CR. ST. C1018	¼ A.N.P.T. ●9/16-18 UNF	¼ A.N.P.T. ●9/16-18 UNF				
3,000 PSI	316 ST. ST.	¼ A.N.P.T.	¼ A.N.P.T.				
	MONEL ALLOY 400 PER QQ-N-281 CLASS A	MS 16142	MS 16142				
	CR. ST. C1018	¼ A.N.P.T.	¼ A.N.P.T.	4 1/8			
1,500 PSI	316 ST. ST.	¼ A.N.P.T.	¼ A.N.P.T.	4	2 15/16	2	2 5/8
	CR. ST C1018	¼ A.N.P.T.	¼ A.N.P.T.				
1,000 PSI	BRASS BAR PER QQ-B-637 COMP 2	MS 16142	MS 16142				
	BRASS BAR PER QQ-B-637 COMP 2	⅛ A.N.P.T.	⅛ A.N.P.T.				
	COPPER NICKEL PER MIL-C-15726	MS 16142	MS 16142				

2. SHAFT ROTATION (SPECIFY):
a. STANDARD: COUNTERCLOCKWISE
b. OPTIONAL: CLOCKWISE (RATINGS UP TO 1500 PSI ONLY) UNIT WITH CCW ROTATION SHOWN. FOR CW ROTATION HIGH & LOW PRESS HOUSINGS ARE INTERCHANGED

1. PROVIDE A 19/32 DIA (CLEARANCE) HOLE FOR ½ HEX

NOTES

NO.	CHANGE	DATE	BY	APP.
11	[illegible]	7-8	JT	VNL
10	ADDED 8-40 UNC 2B [illegible]	7-15-75	JT	VNL
9	DELETED .250 C'SINK	7-14-75	JT	CF
8	ADDED MONEL M & BRT	7-28-69	RC	VNL
7	INCORPORATED CR3748	5-12-69	RC	
6	REVISED & REDRAWN	2-7-69	RH	VNL

MAT'L
FINISH
LIMITS ON DIMENSIONS UNLESS OTHERWISE NOTED: DECIMAL ± .005; ANGULAR ± 1/2°; FRACTIONAL ± 1/32; CONCEN. WITHIN .005

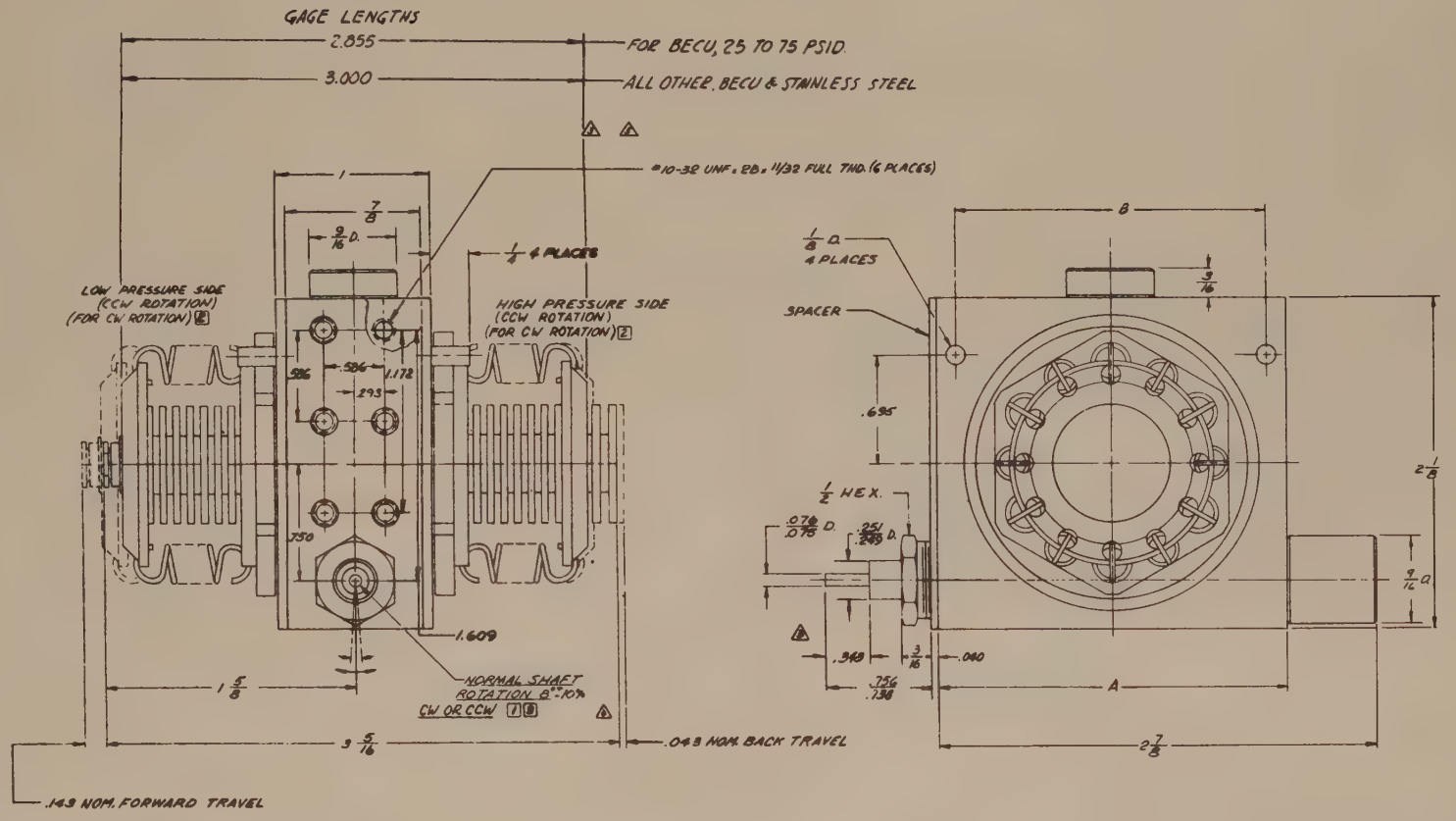
SCALE NONE
DATE 2-7-69
DRAWN M. HAMMA
CHECKED [illegible]
APPD. VNL

BARTON INSTRUMENT CORPORATION MONTEREY PARK, CALIF., U.S.A. SUBSIDIARY OF ITT

OUTLINE DIM. MODEL 224 DIFF. PRESS. UNIT, YOKE OR WALL MTG.

SUPERSEDES [illegible] SUPERSEDED

DWG 0224-0901-3 017



400 PSI	ALUMINUM	316 ST. ST.	2	1 3/4
10,000 PSI	E 4140 ALLOY ST	316 ST. ST.	2 1/4	2
		BE-CU		
6000 PSI	316 ST. ST.	316 ST. ST.		
	C.R. ST. C101B	316 ST. ST.		
		BE-CU		
3000 PSI	316 ST. ST.	316 ST. ST.		
	C.R. ST. C101B	316 ST. ST.		
		BE-CU		
1600 PSI	316 ST. ST.	316 ST. ST.	2	1 3/4
	CR ST. B1113	BE-CU		
500 PSI 1000 PSI	BRASS QQ-B-637 #2	BE-CU		
	CUNI. PER MIL-C-15726	316 ST. ST.		
		BE CU		
PRESSURE RATING	CENTER BLOCK-MATERIAL	BELLOWS MATERIAL	A	B

3. SHAFT ROTATION TO BE SPECIFIED:
STANDARD: COUNTER CLOCKWISE
OPTIONAL: CLOCKWISE
2. HIGH & LOW PRESSURE BELLOWS ARE INTERCHANGED FOR CW ROTATION OF SHAFT
1. CW ROTATION OF SHAFT AVAILABLE ON RATINGS UP TO 1500 P.S.I. DIFF.

NOTE:

NO.	CHANGE	DATE	BY	APP.
9	ADDED GAGE LENGTHS	6-18-76	JT	WNL
8	ADDED 400 & 350 PSI ADDED	3-31-76	JT	WNL
7	ADDED 400 & 350 PSI ADDED	9-26-75	JT	WNL
6	INCORPORATED CR3242	9-18-65	RL	JCB
5	HARDEN PATTERN HOLES REMVD	10-5-67	VY	WNL
4	400 P.S.I ALUM. REMVD.	8-27-67	NLO	WNL
3	GENERAL REVISION	9-24-65	JDB	RL
2	PER SPEC MMS-MK SMC D-999-B	9-28-61	JD	WNL
1	250 PSI M.S. 500 PSI, 2 1/2 MMS-MK	8-26-59	JC	JJ
	2 1/2 MMS-M			

MAT'L
SIZE
FINISH
LIMITS ON DIMENSIONS UNLESS OTHERWISE NOTED: DECIMAL ± .005, ANGULAR ± 1/2°, FRACTIONAL ± 1/32, CONCEN. WITHIN .005
SCALE NONE
DRAWN
CHECKED
APPD.

BARTON INSTRUMENT CORP.
MONTEREY PARK, CALIF.

OUTLINE DIM-MODEL 224 8" DIA BELLOWS UNIT ASSEMBLY

SUPERSEDING
SUPERSEDED
DWG. 0224090B-3 9.

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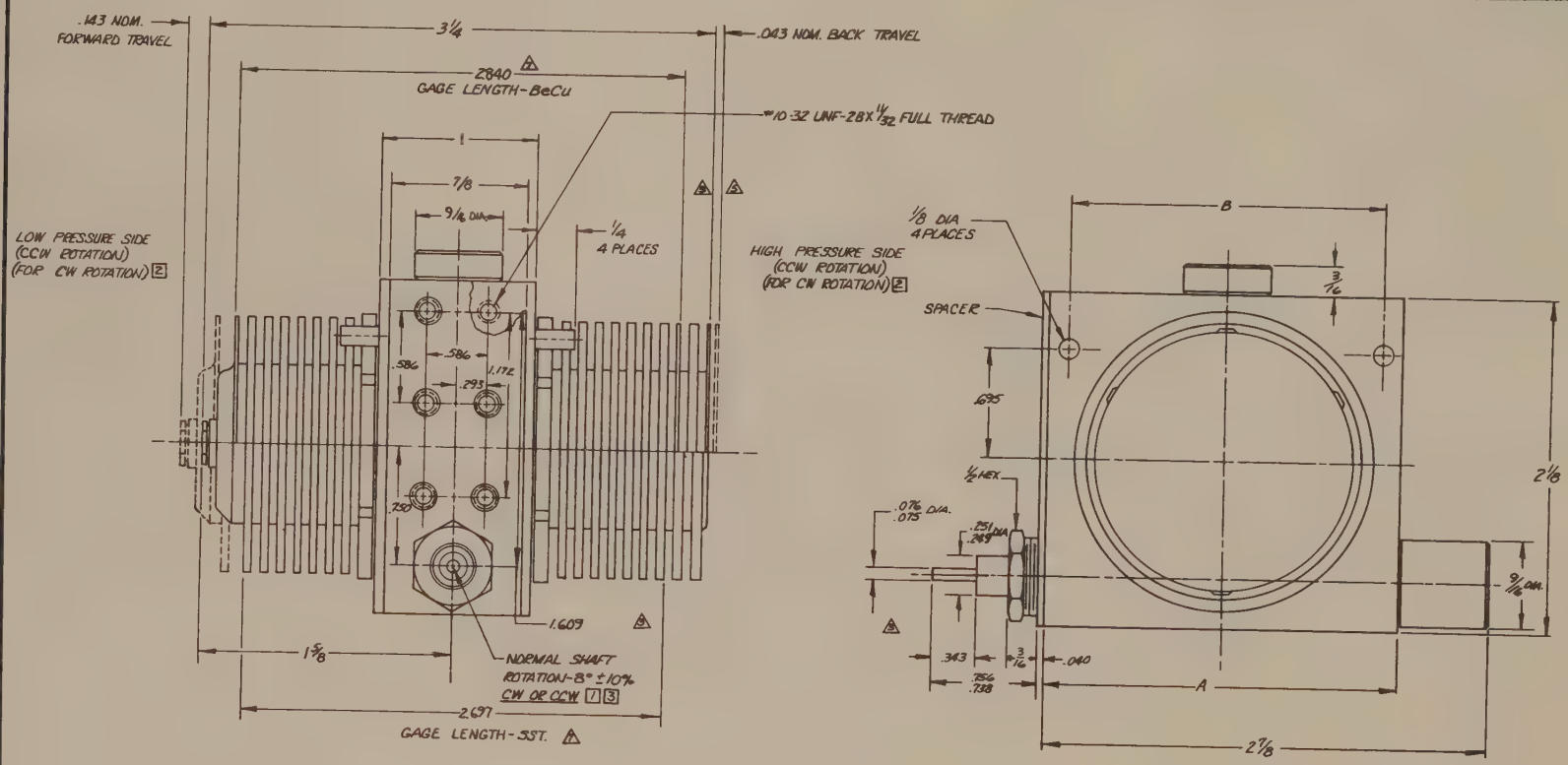
REV	DCR	DESCRIPTION	DATE	DWN	CHK	APP'D
7	4955	REVISED & REDRAWN	4-14-71	J.H.	MM	VNL
8	7011	ADDEDED 400 PSI & 500 PSI	1-26-73	RJ	RM	VNL
9	6491	8°±10% WAS 8°+5% -10%	1-21-75	J.T.	RM	VNL



400 PSI	ALUMINUM	316 SST.	2	1¾
10,000 PSI	E 4140 ALLOY ST	316 SST. / BE-CU.	2¼	2
6000 PSI	316 SST.	316 SST. / 316 SST. / BE-CU.		
	C.R. ST. C1018			
3000 PSI	316 SST	316 SST / 316 SST. / BE-CU.		
	C.R. ST. C1018			
1500 PSI	316 SST.	316 SST	2	1¾
	C.R. ST. B1113	BE-CU.		
500 PSI 1000 PSI	BRASS QQ-B-637 #2	BE-CU.		
	CUNI. PER MIL-C-15726	316 SST. / BE-CU.		
PRESSURE RATING	CENTER BLOCK MATERIAL	BELLOWS MATERIAL	A	B

3 SHAFT ROTATION TO BE SPECIFIED
STANDARD: COUNTER CLOCKWISE
OPTIONAL: CLOCKWISE

2 HIGH & LOW PRESSURE BELLOWS ARE INTERCHANGED FOR CW ROTATION OF SHAFT.

1 CW ROTATION OF SHAFT AVAILABLE ON RATINGS UP TO 1500 PSI ONLY.

NOTES:

UNLESS OTHERWISE SPECIFIED
FRACT. ± 1/32 HOLE SIZES
.XX ± .01 0 - .125 + .004 - .001
.XXX ± .005 .126 - .250 + .005 - .002
ANGLES ± 2° .251 - .500 + .008 - .003
⊙ TIR .501 - UP + .010 - .004
⊥ TIR
BREAK SHARP EDGES .01 MAX. RAD
MACHINED SURFACES 125
SUPERSEDES 03-224-904-7 SUPERSEDED BY

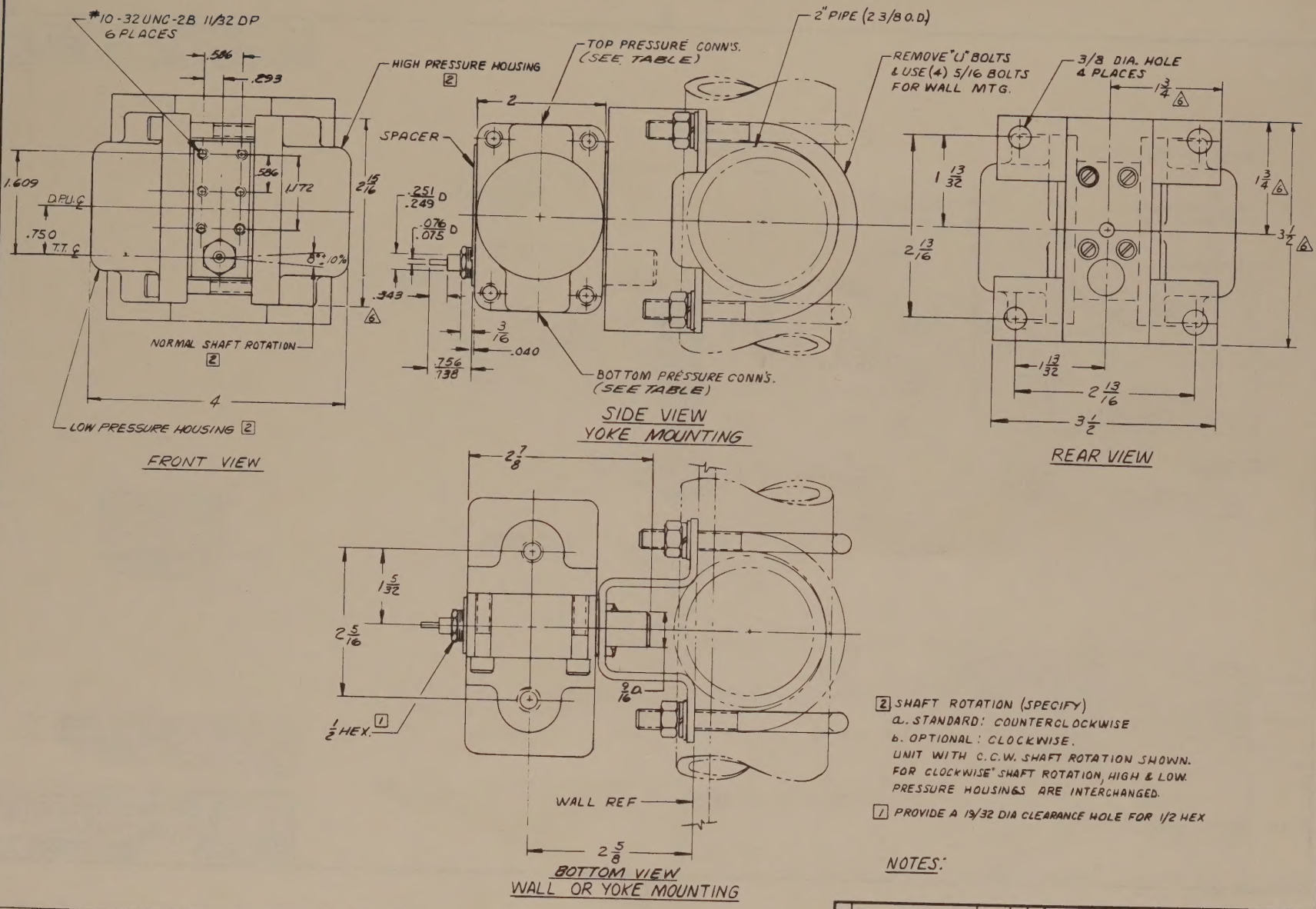
DWN YAMASHITA 1-5-59
CHK MM 1-5-59
ENG
APP'D CB
MAT'L
FIN.

ITT BARTON MONTEREY PARK, CALIFORNIA
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

OUTLINE DIM MODEL 224 1⅛ O.D. BELLOWS UNIT ASSY.

CODE IDENT NUMBER 05991 | DOCUMENT NUMBER 0224-0904-3 | SHEET 1 of 1 | REV 009

1-71 DIETERICH-POST CLEARPRINT 1000 FORM D2-12-2



[2] SHAFT ROTATION (SPECIFY)
a. STANDARD: COUNTERCLOCKWISE
b. OPTIONAL: CLOCKWISE.
UNIT WITH C.C.W. SHAFT ROTATION SHOWN.
FOR CLOCKWISE SHAFT ROTATION, HIGH & LOW PRESSURE HOUSINGS ARE INTERCHANGED.

[1] PROVIDE A 19/32 DIA CLEARANCE HOLE FOR 1/2 HEX

NOTES:

500 PSI	FORGED BRASS ASTM-B-124 #2	1/4 NPT	1/4 NPT
400 PSI	CAST ALUMINUM #360	MS16142	MS16142
PRESS. RATING	HOUSING MATERIAL	1/8 NPT TOP PRESS. CONN.	1/8 NPT BOTTOM

NO.	CHANGE	DATE	BY	APP.
8	6.99 ± 10" to MAX 8° ± 1°	1-20-71	JT	JAL
7	2" 400 PSI ALUM. ADDED	7-16-71	RJ	VNL
6	A413 ADD DIM. E MS16142	5-19-69	CNO	VNL
5	INCORPORATED CR2242	9-12-68	RL	X
4	REVISED & REDRAWN	2-21-68	VH	VNL

MAT'L
SIZE
FINISH
LIMITS ON DIMENSIONS UNLESS OTHERWISE NOTED
DECIMAL ± .005
ANGULAR ± 1/2°
FRACTIONAL ± 1/32
CONCEN. WITHIN .005

SCALE NONE
DATE 21 FEB 68
DRAWN MEAD
CHECKED
APPR.

BARTON INSTRUMENT CORPORATION
MONTEREY PARK, CALIF., U.S.A.
SUBSIDIARY OF ITT

OUTLINE DIM. M224 DIFF. PRESS. UNIT
400 PSI CAST ALUM. & 500 PSI FORGED BRASS, WALL OR YOKE MOUNTING

SUPERSEDES
DWG 0224-0912.3 REV 8

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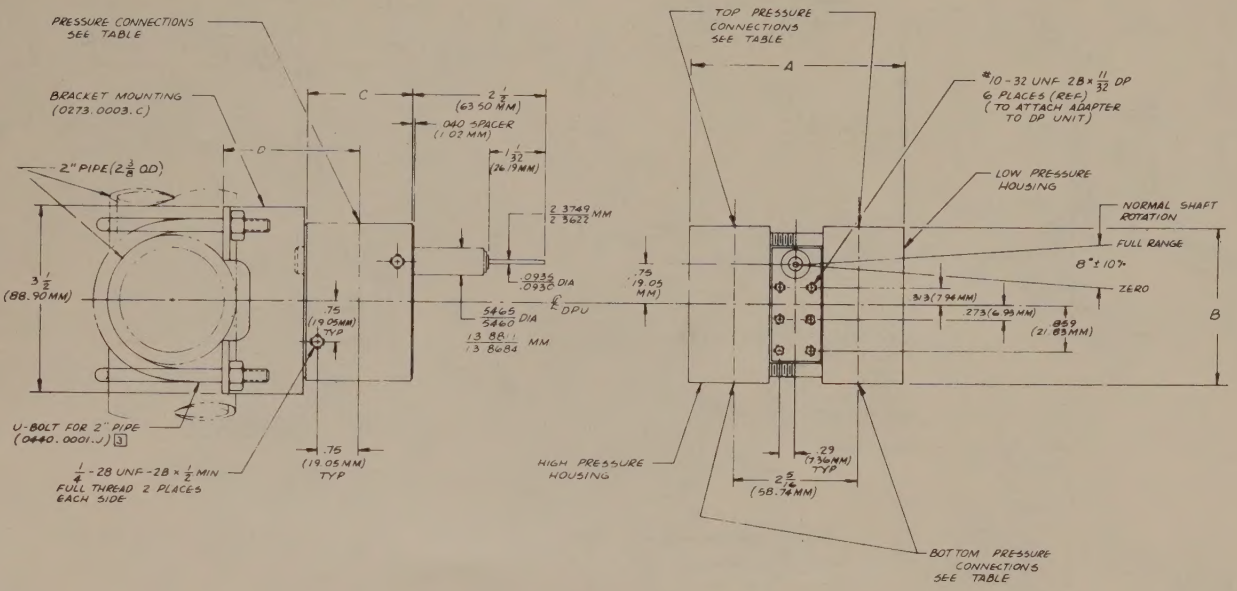
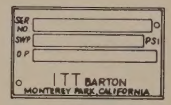
REV	ED	DESCRIPTION	DATE	DWN	CHK	APP'D
001	G411	PRODUCTION RELEASE	9-26-74	BL	EM	WAL
002	GA91	#10-32 WAS +3° -10° NORMAL SHAFT ROTATION	10/7/76	JT	EM	WAL





DPU DATA PLATE

PRESSURE RATING	HOUSING MATERIAL	TOP PRESSURE	BOTTOM CONNECTION	A	B	C	D
6,000 PSI	316 SST	1/2 A.N.P.T. [1] [2] 3/16-18 UNF	1/4 A.N.P.T. [1] [2] 3/16-18 UNF	4 3/8 (111.13 MM)	3 1/4 (82.55 MM)	2 1/4 (57.15 MM)	2 3/4 (69.85 MM)
	CR. ST. C1018	1/2 A.N.P.T. [1] [2] 9/16-18 UNF	1/4 A.N.P.T. [1] [2] 3/16-18 UNF				
3,000 PSI	316 SST	1/2 A.N.P.T.	1/4 A.N.P.T.				
	MONEL ALLOY 400 PER QQ-N-281 CLASS A	MS16142	MS16142				
	CR. ST. C1018	1/2 A.N.P.T.	1/4 A.N.P.T.	4 1/8 (104.78 MM)			
1,500 PSI	316 SST	1/4 A.N.P.T.	1/4 A.N.P.T.				
	CR. ST. C1018	1/4 A.N.P.T.	1/4 A.N.P.T.				
1,000 PSI				4 (101.60 MM)	4 15/16 (74.61 MM)	2 (50.80 MM)	2 5/8 (66.68 MM)
	NICKEL ALUMINUM BRONZE PER QQ-B-673 COMP 2	1/8 A.N.P.T.	1/8 A.N.P.T.				
	COPPER NICKEL PER MIL-C-15726	MS 42	MS16142				

[3] REMOVE U-BOLTS AND USE (4) 5/16 BOLTS FOR WALL MTG.
[2] SUITABLE FOR USE WITH AMINCO FITTINGS (AMERICAN INST. CO., SILVER SPRINGS, MD) OR EQUIV.
[1] CAN BE REVERSED WHEN ORDERED OR CAN BE ROTATED 180° IN THE FIELD.

NOTES:

UNLESS OTHERWISE SPECIFIED			DWN	9/25/74	ITT BARTON MONTEREY PARK, CALIFORNIA INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION
FRACT ± 1/32	HOLE SIZE		CHK EM	9/26/74	OUTLINE DIMENSIONS FOR MODEL 226 DIFF. PRESS. UNIT EXTENDED SHAFT
XX ± .01	0 - 125	.001	ENG		
XXX ± .005	126 - 250	.002	APP'D WAL	9/26/74	
ANGLES ± 2°	251 - 500	.003			
D 7/8	501 - UP	.004			
L 7/8					
BREAK SHARP EDGES .01 MAX. RADIUS			MAT'L		
MACHINED SURFACES 125					
SUPERSEDES	SUPERSEDED BY		FIN		

CODE IDENT NUMBER 05991 | DOCUMENT NUMBER 0224-1047-3 | SHEET 1 | REV 002

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